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Title: Integrated Initiative for Plutonium and Actinide Missions

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Los Alamos
NATIONAL LABORATORY
EST. 1943
OCTOBER 2020
INTEGRATED INITIATIVE FOR PLUTONIUM AND ACTINIDE MISSIONS
EXCELLENCE IN MISSION-FOCUSED SCIENCE, TECHNOLOGY, ENGINEERING, AND MANUFACTURING
XX-123456-78-90XX
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ON THE COVER:

Single crystals of $CeCoGa_5$ and $PuCoGa_5$ compounds that exhibit localized-delocalized f-electron behaviors, a hallmark of highly correlated materials. The cerium compound is a surrogate system for the plutonium-based superconductors.

LOS ALAMOS NATIONAL LABORATORY
managed by TRIAD NATIONAL SECURITY, LLC,
for the NATIONAL NUCLEAR SECURITY ADMINISTRATION
of the UNITED STATES DEPARTMENT OF ENERGY
under contract 89233218CNA000001.

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Letter from the Director of Actinide Operations

The plutonium and actinide missions at Los Alamos National Laboratory play a paramount role in assuring the safety, security, and effectiveness of the nation's nuclear stockpile. Now more than ever as we ramp up to support the next generation of weapons manufacturing and development, it is imperative that we recognize that our mission is bigger than us. By that I mean two things: (1) our mission is bigger than manufacturing or science or engineering or site mission operations alone—it takes a village to ensure sustainable success and (2) our mission is bigger than Los Alamos National Laboratory—it is part of the National Nuclear Security Administration's greater Nuclear Security Enterprise.

Together we face great challenges across our eight mission areas that include science, technology, and engineering to deliver ***manufacturing results*** involving multiple isotopes of plutonium as well as americium and uranium. We have been trusted with a great responsibility to deliver world class science, technology, engineering, and manufacturing for the National Nuclear Security Administration and its end-user partners at the Department of Defense, National Aeronautics and Space Administration, Department of Homeland Security, Department of Energy Office of Science, Department of Energy Office of Nuclear Energy, and the oil and gas industry—to meet the needs of today, tomorrow, and decades to come.

Our future success will be enabled only through an integrated initiative for plutonium and actinide missions. Science, technnlogy, engineering, manufacturing, and site operations must work ***seamlessly together*** to deliver on the goals, objectives, strategic capability priorities, and actions for Fiscal Year 2021 that comprise our integrated initiative.

I am proud to have been asked to inspire the development and implementation of an integrated initiative for plutonium and actinide missions. I am excited about this because it represents a renewed call to action to work more closely together—through ***integrated mission delivery***—for the greater good of the American people and in service of the interests of our nation's Allies around the world. Our plutonium and actinide missions agenda item includes four major elements:

(1) identify and document internal strategic priorities for actinide capabilities

(2) engage stakeholders to draft a science, technology, and engineering roadmap to achieve our strategic goals

(3) provide recommendations for FY 2021 actions

(4) work with stakeholders to develop and implement a stewardship model for actinide missions, with an emphasis on the Laboratory's role as the Plutonium Center of Excellence

To be successful, we must (1) embrace a next generation enterprise that is flexible to enable ***rapid deployment*** and that consistently delivers through ***assured manufacturing;*** (2) develop a ***next generation workforce*** poised to create great science that enables plutonium and actinide missions success; and (3) ***modernize*** and expand our ***infrastructure*** and capabilities to support our nation's current and future needs. Together, we will ensure a safe and secure nuclear weapons stockpile, reduce global nuclear threats through nonproliferation efforts, and support space and energy exploration.

Frank E. Gibbs

FRANK GIBBS
Director of Actinide Operations for Los Alamos National Laboratory

Frank Gibbs engaging Alissa Tatro of AMPP-1 with mock RTG in hand

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Acronyms and Abbreviations

ABQ	Albuquerque
AIGRB	Actinide Integrated Governance and Review Board
ALD	Associate Laboratory Director
ALDWP	Associate Laboratory Directorate, Weapons Production
ARIES	Advanced Recovery and Integrated Extraction System
CMR	Chemistry and Metallurgy Research
DFM	Design for Manufacturing
DHS	Department of Homeland Security
DoD	Department of Defense
DOE	Department of Energy
DOE-NE	DOE Office of Nuclear Energy
DOE-SC	DOE Office of Science
DOE-SR	DOE Savannah River Operations Office
DOT	Department of Transportation
DPBPS	Defense Programs Business Practices System
DSA	Documented Safety Analysis
DYMAC	DYnamic MAterials Control
EPA	Environmental Protection Agency
ESHQSS	Environment, Safety, Health, Quality, Security and Safeguards
FBI	Federal Bureau of Investigation
FMH	Fissionable Material Handler
FPU	First Production Unit
FTE	Full-Time Equivalent
FY	Fiscal Year
GBO	Glovebox Operator
GPHS	General Purpose Heat Source
GRA	Graduate Research Assistant
GTSI	Glenn T. Seaborg Institute
HEU	Highly Enriched Uranium
HR	Human Resources
ICE	Isentropic Compression Experiments
INL	Idaho National Laboratory
KCNSC	Kansas City National Security Campus
kg	kilogram
LA	Los Alamos
LANSCE	Los Alamos Neutron Science Center
LBNL	Lawrence Berkeley National Laboratory
LDRD	Laboratory Directed Research and Development
LEP	Life Extension Program
LEU	Low-Enriched Uranium
LLMW	Low-Level Mixed Waste
LLNL	Lawrence Livermore National Laboratory
LL-RLW	Low-Level Radioactive Liquid Waste
LLW	Low-Level Waste
LWRHU	Light Weight Radioisotope Heater Unit
MAR	Material-at-Risk
MFR	Mission Foundations Research

Acronyms and Abbreviations (continued)

MRL	Manufacturing Readiness Level
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NDE	Non-Destructive Evaluation
NEPA	National Environmental Policy Act
NEST	Nuclear Enterprise Science & Technology
NET	New Employee Training
NMC&A	Nuclear Material Control and Accountability
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NPR	Nuclear Posture Review
NSE	Nuclear Security Enterprise
NSS	National Security Strategy
ORNL	Oak Ridge National Laboratory
PF	Plutonium Facility
PPO	Partnerships & Pipeline Office
ppy	pits per year
R&D	Research and Development
RAM	Responsibility Assignment Matrix
RANT	Radioactive Assay and Nondestructive Testing
RC	Radiochemistry
RLUOB	Radiological Laboratory, Utility, Office Building
RLWTF	Radioactive Liquid-Waste Treatment Facility
RPS	Radioisotope Power Systems
RTG	Radioisotope Thermoelectric Generator
SCE	Subcritical Experiment
SFCC	Santa Fe Community College
SIP	Strategic Investment Plan
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SMPs	Safety Management Programs
SNL	Sandia National Laboratories
SNM	Special Nuclear Materials
SPD	Space Policy Directive
SRNL	Savannah River National Laboratory
SRPPF	Savannah River Plutonium Production Facility
SRS	Savannah River Site
SSMP	Stockpile Stewardship and Management Plan
ST&E	Science, Technology, and Engineering
TA	Technical Area
TAMU	Texas A&M University
TFF	Target Fabrication Facility
TLW	Transuranic Liquid Waste
TRL	Technology Readiness Level
TRU	Transuranic
TWF	Transuranic Waste Facility
U.S.	United States
WCRRF	Waste Characterization, Reduction, and Repacking Facility
WIPP	Waste Isolation Pilot Plant
WR	War Reserve
Y-12	Y-12 National Security Complex

EXECUTIVE SUMMARY

1

EXECUTIVE SUMMARY

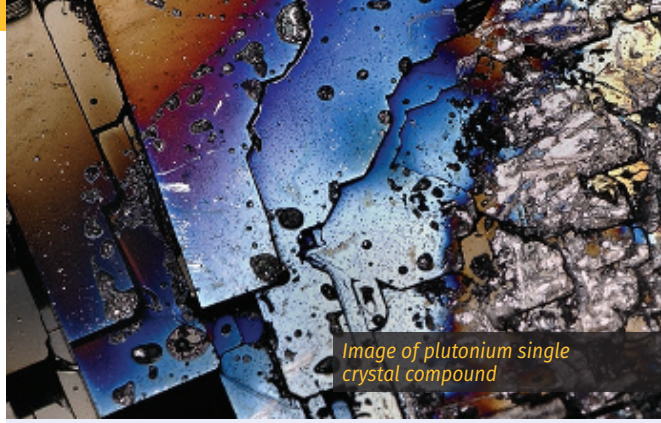


Image of plutonium single crystal compound

Recognizing the dynamic environment and challenges facing the plutonium and actinide missions at Los Alamos National Laboratory over the next decade, Laboratory leadership established Fiscal Year (FY) 2020 **Laboratory Agenda Item 2.6**. This agenda item calls for the development and implementation of an integrated initiative for plutonium and actinide missions at Los Alamos. Over the next decade, Los Alamos has been asked to significantly ramp up pit production to help address nuclear stockpile and nuclear deterrence needs, heat source production to support expansion in space exploration, evaluation of stockpile returns, processing operations in support of nonproliferation, and the actinide science to support all of these efforts. All of this must be accomplished while significantly increasing the size of our plutonium and actinide missions workforce and modernizing and updating critical infrastructure. Only through enhanced integration of science, technology, and engineering (ST&E), manufacturing, and mission operations will we enable achievement of these critical missions. An overall summary of the plutonium and actinide missions is included in **Figure 1** on *Page 3* and **Figure 2** on *Page 4* summarizes our goals, objectives, FY 2021 recommended actions and internal strategic priorities that are key elements of our integrated initiative.

The core team established to respond to Agenda Item 2.6 is led by Frank Gibbs, Director of Actinide Operations, and includes Stacy McLaughlin (Bullet #1 Lead), Franz Freibert (Bullet #2 Lead), Stephen Schreiber (Bullet #3 Lead), Frank Gibbs (Bullet #4 Lead), David Clark, Drew Kornreich, Bob Putnam, and Evelena Valencia.

Integrated Initiative Highlights

- Four overarching goals
- 12 SMART objectives
- Description of eight mission areas and four key enablers
- Identification of 29 capability needs over the next 10 years
- An ST&E Roadmap focused on bridging the gap between foundational science and applied science to deliver on the mission
- Realization of the Plutonium Center of Excellence
- Plutonium and actinide missions focus area for "Applied Science for Integrated Plutonium and Actinide Mission Delivery"
- 32 FY 2021 recommended actions
- A Stewardship Model aligned with NNSA governance expectations and which includes leadership, governance, and stewardship
- A detailed responsibility assignment matrix (RAM) with clear roles and responsibilities for actinide missions

Strategic Context, Mission Areas, and Enablers

In keeping with the spirit of a truly integrated initiative, the team holistically addressed the plutonium and actinide missions. We began by examining the broader context of these missions and how they fit into the mission, vision, and values of the National Nuclear Security Administration (NNSA) and Los Alamos. To establish a sound framework for the response, we established four overarching goals supported by 12 specific, measurable, achievable, relevant, and time-bound (SMART) objectives with clear delivery timeframes. The overarching goals established for the integrated initiative for actinide missions include (1) integrated mission delivery, (2) rapid deployment, (3) assured manufacturing, and (4) next generation workforce. These goals and the 12 corresponding objectives are included in **Figure 2** and discussed in *Section 2*. In *Section 3* we describe the context of the strategic environment that shape our missions and in *Section 4* we outline the overarching policy directives which are the very basis for our plutonium and actinide missions—our *raison d'être*. *Section 5* describes the organizational and governance structure in which we operate and *Section 6* summarizes our eight mission areas and four mission enablers. Together, these five sections set the stage for our response to **Laboratory Agenda Item 2.6**.

Integrated Initiative for Plutonium and Actinide Missions

Section 7 contains our response to **Laboratory Agenda Item 2.6**. Using our overarching goals and objectives as our foundation, this initiative includes four major elements:

Internal Strategic Priorities for Actinide Capabilities (2.6 Bullet #1)

The team identified 11 near-term (1 year), 9 mid-term (2-3 years), and 9 long-term (4-10 years) capability needs across the areas of science, engineering, and technology to meet manufacturing commitments. These capability needs are provided in *Section 7.1*.

ST&E Roadmap (2.6 Bullet #2)

Our team has developed a draft ST&E Roadmap (*Section 7.2*) and has initiated stakeholder engagement activities per our stakeholder engagement plan. Our ST&E Roadmap proposes establishment of a new programmatic focus area titled "Applied Science for Integrated Plutonium and Actinide Mission Delivery." Our ST&E Roadmap includes an emphasis on bridging the gap between foundational science and science that delivers the mission and plans for the realization of the Plutonium Center of Excellence for Research and Development (Plutonium Center of Excellence)—including excellence in pit manufacturing, research and development, and design.

FY 2021 Recommended Actions (2.6 Bullet #3)

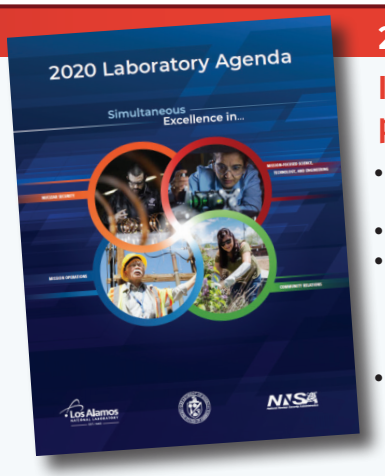
The team developed 32 near-term (FY 2021) recommended actions for implementation of the integrated initiative. Importantly, these actions are aligned to our 12 objectives and our four overarching goals. Our goals, objectives, and actions are aligned to the NNSA Headquarters mission and vision as well as top level policy directives. These actions are included in *Section 7.3*.

Stewardship Model for Actinide Missions (2.6 Bullet #4)

Section 7.4 presents our draft Stewardship Model and corresponding responsibility assignment matrix (RAM). We have developed a list of key stakeholders for the Stewardship Model and have initiated engagement activities. Broadly aligning with stewardship theory, our model includes elements of leadership, stewardship, and governance, and has been adapted to align with NNSA's key expectations regarding governance and management.

Conclusion and Roadmap

Conclusions and next steps are included in *Section 8* and a summary roadmap to the future in **Figure 25** on *Page 46*.



2020 LOS ALAMOS NATIONAL LABORATORY AGENDA

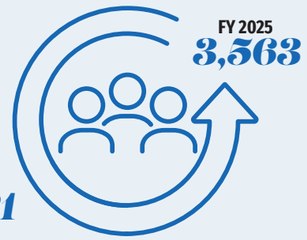
Item 2.6: Develop and implement an integrated initiative for plutonium and actinide missions

- **Bullet #1** Identify and document internal strategic priorities for actinide capabilities (science, engineering, manufacturing) for the near, mid, and long term *(Lead: Stacy McLaughlin)*
- **Bullet #2** Engage stakeholders to draft an ST&E roadmap to achieve our strategic goals (Lead*: Franz Freibert)*
- **Bullet #3** Provide recommendations for FY 2021 actions, considering management and application of multiple isotopes of Pu: separation/recovery; alloys, materials, and manufacturing; safety, criticality, and security; and linkages with Lab infrastructure planning for radiological and nuclear facilities *(Lead: Stephen Schreiber)*
- **Bullet #4** Work with key stakeholders to develop and implement a stewardship model for actinide missions, with an emphasis on the Laboratory's role as the plutonium center of excellence; integrate this model with long-term program priorities in nuclear weapons, in global security, and with DOE *(Lead: Frank Gibbs)*

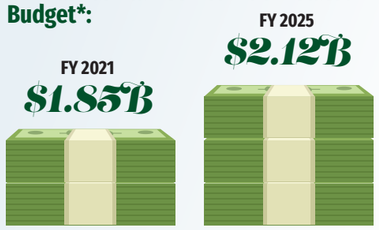
Figure 1

PLUTONIUM AND ACTINIDE MISSIONS AT A GLANCE

Number of Employees:



Annual Los Alamos Actinide-Related Budget*:



Funding Sources: NNSA-10, NNSA-50, NNSA-20, NNSA-70, DOE NE-3, DOE SC, DOE SR

**Note: Dollar value does not include uranium mission budget.*

PLUTONIUM AND ACTINIDES WORKFORCE MAKEUP

Special Material Machinists, Radiation Control Technicians, Operations Center Supervisors, First-Line Managers, Quality Assurance/Quality Control Inspectors, R&D Engineers, Research Technicians and Technologists, Quality Performance Assurance Specialists, Quality Assurance Engineers, Manufacturing Managers, Designers/Drafters, Configuration Specialists, Operations Support Specialists, Project Managers, Engineering Technologists, Scientists, Security Specialists, Nuclear and Hazardous Materials Technicians, Mechanical Engineers, Production Control Specialists, Subcontract Specialists, Project Controls Specialists

8 Plutonium and Actinide Mission Areas

1. Produce Plutonium Pits
2. Produce Heat Sources/RTGs
3. Evaluate Pits Returned from the Stockpile
4. Process Plutonium for Nonproliferation
5. Produce Plutonium Components for Subcritical Experiments
6. Conduct Science on Material Properties and Aging of Plutonium
7. Recover Americium
8. Conduct Uranium Operations

MANUFACTURES:
Plutonium Pits, RTGs, Heat Sources, Subcritical Devices

PRODUCES:
Plutonium Metals and Alloys, Plutonium Oxide, Americium Oxide, Highly Enriched Uranium (excess/recycled), Depleted Uranium

NNSA
National Nuclear Security Administration

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

6 End-User Partners:
DOE SC, DOE NE, DoD, NASA, Department of Homeland Security, Oil and Gas Industry

NASA

U.S. DEPARTMENT OF ENERGY
Office of Science

10 DOE SENDER/RECEIVER SITE INTERFACES:

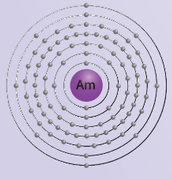
LLNL, SNL, KCNSC, Pantex, Y-12, NNSS, SRS, DOE-SC, INL, WIPP

5 MAIN ISOTOPES:

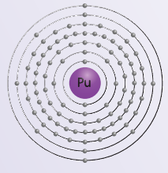
^{239}Pu, ^{238}Pu, ^{241}Am, ^{235}U, ^{238}U

3 FUNDAMENTAL ELEMENTS:

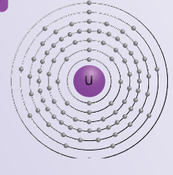
Plutonium, Americium, Uranium



95 (243)
Am
Americium



94 (244)
Pu
Plutonium



92 238.02
U
Uranium

Plutonium Facility (PF)-4 at TA-55

In operation since 1978, PF-4 is the work horse of plutonium and actinide missions. Operations housed in this 233,000-square-foot nuclear facility include: pit production operations, ^{238}Pu programs, ^{239}Pu programs, plutonium recovery, americium recovery, americium oxide production, pit disassembly, materials testing, coring and machining, plutonium disposition operations, and material recycle and recovery.

13 FACILITIES KEY TO PLUTONIUM AND ACTINIDE MISSIONS:

PF-4*, CMR, RLUOB*, PF-5, TA-8 NDE Shop, SCE, SM-39, Sigma, TLW*, RLWTF*, TWF*, RANT*, LANSCE

**Nuclear facilities*

Components for nuclear weapons

Plutonium metal processing mission

8 NASA MISSIONS SUPPORTED:

Galileo, Ulysses, Mars Pathfinder, Cassini-Huygens, Mars Exploration Rovers, New Horizons, and Mars Science Laboratory, Future 2026 Dragonfly

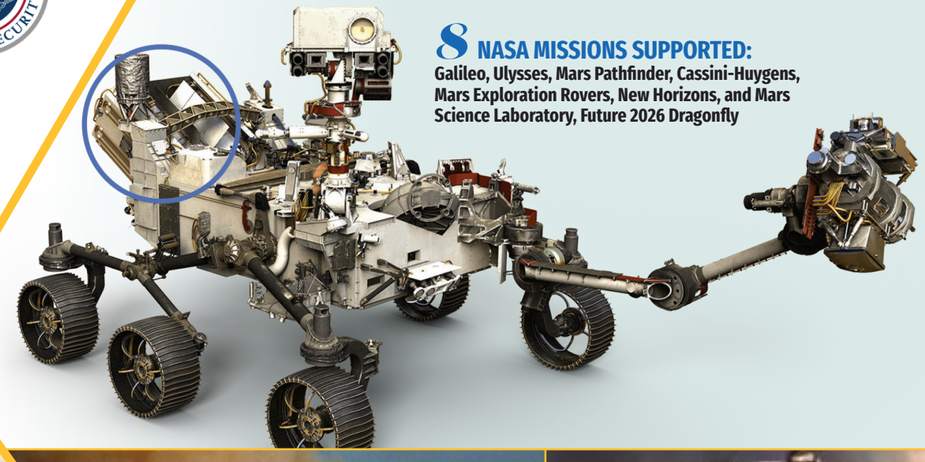


Figure 2 Plutonium and actinide missions overall goals, objectives, actions, and capabilities

OBJECTIVES	FY 2021 RECOMMENDED ACTIONS
GOAL #1 INTEGRATED MISSION DELIVERY	**Optimize integration of manufacturing, ST&E, and mission operations to deliver next generation solutions for plutonium and actinide missions.**
Objective 1A: Leverage existing Laboratory Directed Research and Development (LDRD) strategy team and new Director's Initiative annual Rapid Response funding to maximize actinide operations science Rapid Response by FY 2023. **Objective 1B:** Update, maintain, and implement the ST&E Roadmap, with a focus on Rapid Response/ science support for actinide missions annually beginning in FY 2020 through FY 2030 and beyond. **Objective 1C:** Bridge the gap from LDRD to implementation. Establish and implement a new Program Technology-Based Development Initiative (direct programmatic, agreed upon contribution to a program) to fund mission delivery-focused actinide science by Q4 FY 2022.	**Action 1:** Work with 3.1 Laboratory Agenda team to establish a senior leadership position and/or direct report organization tasked with the integration of ST&E, Mission Operations, and the Weapons Mission, including integration of plutonium and actinide missions. This new organization would drive horizontal integration across our vertical chain of command. **Action 2:** Establish Actinide Operations and Pit Program membership and representation for LDRD Strategy Team to increase Weapons Production/Actinide Operations participation. Achieve and sustain continuous participation beginning Q1 FY 2021. **Action 3:** Work with the Seaborg Institute to award FY 2021/FY 2022 Rapid Response projects in enhanced actinides metal separation and purification science to advance capabilities needed to enable Laboratory mission agility and scientific advancement by Q3 FY 2021. **Action 4:** Demonstrate meaningful progress on 2020 projects under the Director's Initiative 2020 LDRD Rapid Response new start projects during FY 2021. **Action 5:** Engage key stakeholders and conduct FY 2021 Annual Update of ST&E Roadmap by Q4 FY 2021. **Action 6:** Ensure inclusion of actinide mission needs in LDRD Mission Foundations Research call for FY 2021 and FY 2022. **Action 7:** Establish an Actinide Integrated Governance and Review Board in FY 2021 through the ALDWP-AO-Technical Applications Office, to bridge technologies from development in LDRD to implementation through shared programmatic return on investment. **Action 8:** Engage key stakeholders and develop drafts of actinide mission-focused Program Development Initiatives by end of Q3 FY 2021.
GOAL #2 RAPID DEPLOYMENT	**Achieve weapon concept to delivery in years versus decades.**
Objective 2A: Fully implement Design for Manufacturing (DFM) by FY 2025 and create first DFM WR-capable pit by FY 2026. **(Ties to Laboratory Agenda Item 1.1)** **Objective 2B:** Fully implement a framework for rapid implementation of Nuclear Security Enterprise Product Realization Process and Defense Programs Business Practices System (DPBPS) process by FY 2023. **Objective 2C:** Leverage use of lower hazard category (radiological) facilities with reduced regulatory burden and greater agility for small-scale science by end of FY 2022.	**Action 9:** Incorporate DFM implementation into existing integrated program baseline by Q2 FY 2021. **Action 10:** Develop rapid DPBPS framework by Q4 FY 2021 working with internal stakeholders. **Action 11:** Link Los Alamos's capabilities in radiological facilities [i.e., Sigma Complex SM-66 at TA-3, Target Fabrication Facility (TFF) at TA-50, Shops SM-39 at TA-3, Radiological Facility at TA-48, etc.] as test beds for solving challenging manufacturing processes such as welding, casting, and mold development. **Action 12:** Create a first draft of an updated Radiological Campus Strategy and implementation plan for small scale science by Q1 FY 2021, conduct engagement of facility owners/stakeholders in Q2-Q3 FY 2021, and finalize it in Q4 FY 2021.
GOAL #3 ASSURED MANUFACTURING	**Achieve predictable and repeatable delivery through focused, standardized, and enabling operational excellence.**
Objective 3A: Establish formal integrated mechanisms to enable assured manufacturing between now and FY 2022. **(Ties to Laboratory Agenda Items 3.2 and 3.3)** **Objective 3B:** Create a broad-based employee and organizational performance incentive structure tied to science and manufacturing mission success for implementation in FY 2023. **(Ties to Laboratory Agenda Items 3.1, 3.2, and 3.5)** **Objective 3C:** Drive creation of a standardized and consistent higher bounding safety basis–Documented Safety Analysis (DSA)–within actinide science and manufacturing facilities by Q4 FY 2024. **(Ties to Laboratory Agenda Items 3.3)** **Objective 3D:** Establish and maintain modernized reliable infrastructure capabilities (facilities, equipment, technology) for predictable program delivery and operational excellence by Q4 FY 2026.	**Action 13:** Implement our Actinide Integrated Governance and Review Board to tie Safety Management Programs (SMPs) to make integrated mission-focused decisions and address critical issues related to NMC&A, nuclear safety, criticality safety, and classification enhancements. Develop the Charter and Board makeup by Q1 FY 2021 and fully implement it by Q4 FY 2021. **Action 14:** Develop needs forecast for support functions (to be updated quarterly) to inform support organizations of needs and requirements 2-5 years out by Q4 FY 2021. **Action 15:** Establish "Fix It Now" Team working with level operations, criticality, nuclear safety, radiological safety, waste, etc. to rapidly address and resolve emerging time-sensitive issues in the field to support sustained manufacturing by Q3 FY 2021. **Action 16:** Develop real-time capability for measurement (i.e., DYMAC) for NMC&A, Criticality Safety, and Safety Basis with nuclear measurement, modeling, and data analysis capabilities by Q4 FY 2021. **Action 17:** Establish new/modernized equipment capability as captured in the Equipment and Infrastructure List to support manufacturing programs by Q4 FY 2021. **Action 18:** Develop a draft of revised employee performance incentive/merit structure by Q4 FY 2021 for execution during the FY 2022 cycle. **Action 19:** Conduct a pilot project to implement an integrated and standardized higher bounding safety basis/Documented Safety Analysis (DSA) for waste facilities by Q4 FY 2021 (including training and Technical Safety Requirements). **Action 20:** Develop an infrastructure capabilities requirements matrix for actinide missions by Q2 FY 2021. **Action 21:** Develop and deploy an agile production management system that will allow for real time production flow and enable electronic product sales building upon the pilot work on heat source production and extending into the Plutonium Sustainment program by 4Q FY2021. **Action 22:** Develop integrated project management, baseline, change control, and business systems, capabilities, and tools to support plutonium and actinide missions by Q4 FY 2021. **Action 23:** Establish a technical baseline capture methodology and capability (IT backbone, security, human resource, process) for the actinide missions/processes by Q4 FY 2021.
GOAL #4 NEXT GENERATION WORKFORCE	**Grow our next generation workforce with a focus on actinide competency.**
Objective 4A: Integrate with Mission Operations to develop and/or hire ~1,400 plutonium and actinide competent workers between now and FY 2025. **(Ties to Laboratory Agenda Items 1.1, 3.5, and 4.2)** **Objective 4B:** Integrate with Mission Operations to develop recruitment, retention, education, and training initiatives for next generation workforce by Q4 FY 2022. **(Ties to Laboratory Agenda Item 1.1 and 3.5)**	**Action 24:** Develop an integrated baseline that ensures inclusion of resource needs to level of detail necessary for workforce competency and capability planning by Q3 FY 2021. **Action 25:** Establish New Employee Training (NET) success with multiple cohorts of technicians trained for glovebox work and fissionable material handling by Q2 FY 2021. **Action 26:** Make investment in pipeline development to support and facilitate Los Alamos actinide missions via: Seaborg postdoctoral fellowships, summer GRA fellowships, new initiative-focused topic GRA fellowships to address specific needs. **Action 27:** Implement human resource capability as found in LA-CP-20-20312, Staffing Plan for Plutonium Missions at Los Alamos National Laboratory. **Action 28:** Implement human resource capability for 2nd shift construction and maintenance operations at TA-55 PF-4. **Action 29:** Initiate Nuclear Enterprise Science & Technology (NEST) program—for technician education and worker qualification in Q1 FY 2021. **Action 30:** Produce first NEST certificate and NET graduates under an integrated NEST Program Q4 FY 2021. **Action 31:** Develop a formal time-phased five-year recruitment plan to support plutonium and actinide missions by Q2 FY 2021. **Action 32:** Complete the Continuing Training Compliance Project by Q4 FY 2022.

CAPABILITIES

SCIENCE CAPABILITIES

NEAR-TERM STRATEGIC PRIORITIES
1. Leverage Seaborg Institute's LDRD Rapid Response call for TRL 1-3 research projects (**Goal 3**)
2. Include mission need in LDRD Mission Foundations Research (TRL 3-5) call (**Goal 2**, **Goal 3**)
3. Invest in workforce development to support and facilitate actinide mission via: Seaborg postdoctoral fellowships, summer GRA fellowships, new initiative-focused topic GRA fellowships to address specific needs (**Goal 3**)

MID-TERM STRATEGIC PRIORITIES
1. Develop and deploy system/program for closing the prototype and system demonstration (TRL 6-9) gap allowing for cradle-to-grave approach from basic research to product deployment (**Goal 2**)
2. Expand workforce pipeline via Seaborg Institute postdoctoral and GRA fellowships paired between manufacturing and science (**Goal 3**)
3. Enhance actinides metal separation and purification science (i.e., enhanced precipitation) (**Goal 2**)

LONG-TERM STRATEGIC PRIORITIES
1. Employ a distributed campus model expanding the current partnerships with universities that make up TAMU, University of California, and other selected universities. Conduct LDRD funded research at these universities and integrate other funding sources that come to the university (**Goal 1**, **Goal 3**, **Goal 4**)
2. Establish surrogate capabilities at designated universities to support the closure of technology gaps (**Goal 3**, **Goal 4**)
3. Integrate these partnerships into the NEST program so that early career engineers and scientists are working real problems while completing their degree (**Goal 4**)

ENGINEERING CAPABILITIES

NEAR-TERM STRATEGIC PRIORITIES
1. Introduce new/modernized equipment capability as captured in the Equipment and Infrastructure List to support manufacturing programs (**Goal 2**)
2. Link Los Alamos's development capabilities in radiological facility (i.e., Sigma, TFF, SM-39) as a test bed for solving challenging manufacturing processes, such as welding, casting, and mold development (**Goal 2**, **Goal 3**)
3. Implement Nuclear Enterprise Science & Technology (NEST) education - for technician pipeline and development (**Goal 4**)
4. Develop technical baseline capture methodology and capability (IT backbone, security, HR, process) for our actinide missions/processes (**Goal 1**)

MID-TERM STRATEGIC PRIORITIES
1. Expand NEST capability through university agreement with TAMU investing in current and planned staff through targeted Master's degree programs (**Goal 4**)
2. Expand capability for analogue/ surrogate testing utilizing Los Alamos's radiological campus (i.e., Sigma, TFF, SM-39) (**Goal 2**, **Goal 3**)
3. Expand environmental test capabilities for actinide products in support of product certification (**Goal 3**)

LONG-TERM STRATEGIC PRIORITIES
1. Implement actinide materials processing and testing capability in PF-4 (**Goal 2**, **Goal 3**)
2. Develop partnership with universities for engineering modeling and surrogate validation of manufacturing processes (**Goal 3**, **Goal 4**)
3. Establish modular manufacturing capabilities at universities to include classified manufacturing testing integrated with operations for future deployment at Los Alamos (**Goal 2**, **Goal 3**, **Goal 4**)

MANUFACTURING CAPABILITIES

NEAR-TERM STRATEGIC PRIORITIES
1. Implement human resource capability as found in LA-CP-20-20312, Staffing Plan for Plutonium Missions at Los Alamos National Laboratory (**Goal 3**, **Goal 4**)
2. Develop and deploy an agile production management system that will allow for real time production flow and enable electronic product sales (**Goal 2**, **Goal 3**)
3. Implement human resource capability for 24-7 construction and maintenance operations at TA-55 PF-4 (**Goal 1**)
4. Integrate project management, baseline, change control, and business systems, capabilities, and tools to support plutonium and actinide missions (**Goal 1**)

MID-TERM STRATEGIC PRIORITIES
1. Develop cost model for the preparation of laboratory space for future programs (including PF-4) (**Goal 2**)
2. Deploy wireless solutions in classified manufacturing environments (**Goal 1**, **Goal 3**)
3. Study alternatives for an expanded capability/ capacity to store/manage TRU waste (including waste minimization) in the event of WIPP shutdown such that Los Alamos's actinide production missions are not disrupted **(Goal 3)**

LONG-TERM STRATEGIC PRIORITIES
1. Establish capability for analogue/surrogate using isotopic purity ^{242}Pu for manufacturing optimization (**Goal 3**)
2. Implement Lean Six Sigma practices to support an optimized flowsheet across product lines and reduce per product footprint allowing for future growth (**Goal 1**)
3. Remove legacy equipment set within PF-4 laboratory spaces providing ready-to-use space for future or expanded missions (**Goal 2**, **Goal 3**)

KEY PROGRESS TO DATE

1. Established real-time capability for measurement (i.e., DYMAC) for NMC&A, Criticality Safety, and Safety Basis – nuclear measurement, modeling, and data analysis capabilities
2. Successfully completed multiple NET cohorts of technicians trained for glovebox work and fissionable material handling
3. Enhanced actinides metal separation and purification science (i.e., enhanced precipitation) – Funding as part of Rapid Response call
4. Established single crystal capability for actinide science
5. Published Integrated Strategy for Plutonium Missions at Los Alamos National Laboratory (LA-CP-20-20372)

STRATEGIC CONTEXT, MISSION AREAS, AND ENABLERS

2

VISION, GOALS, AND OBJECTIVES

Our vision for the future for plutonium and actinide missions is aligned to the mission, vision, and values of our customer—the NNSA—as well as those of the Laboratory. Central to both is a commitment to our nation, the protection of national security, and the pursuit of excellence. ***Our vision is:*** *To achieve integrated mission delivery, rapid deployment, and assured manufacturing through the world class capabilities of our next generation workforce.* At the foundation of our success are the following four overarching goals.

GOAL #1: INTEGRATED MISSION DELIVERY
Optimize integration of manufacturing, ST&E, and mission operations to deliver next generation solutions for plutonium and actinide missions.

GOAL #2: RAPID DEPLOYMENT
Achieve weapon concept to delivery in years versus decades.

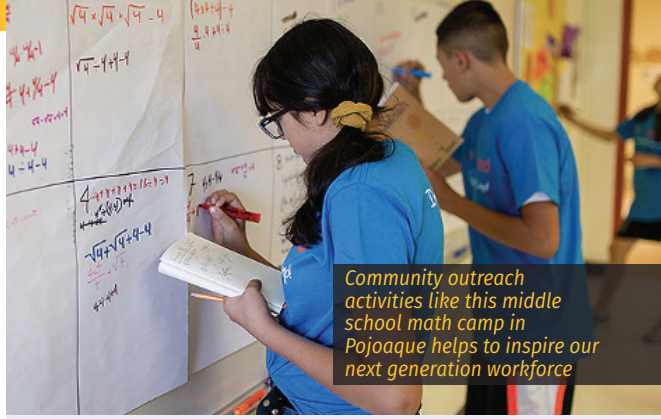
GOAL #3: ASSURED MANUFACTURING
Achieve predictable and repeatable delivery through focused, standardized, and enabling operational excellence.

GOAL #4: NEXT GENERATION WORKFORCE
Grow our next generation workforce with a focus on actinide competency.

The key to success in implementation of our integrated initiative is the achievement of goals through objectives that are **SMART**–specific, measurable, achievable, relevant, and time-bound. **Figure 3** *on the following page* provides our key objectives under each of our four goals. Our FY 2021 recommended actions in response to **Laboratory Agenda Item 2.6, Bullet #3** are included in *Section 7.3*.

And, at the center of it all is the recognition of the fundamental role that Los Alamos has been entrusted with as the NNSA designated Plutonium Center of Excellence. We will build upon, formalize, and leverage this role to enable plutonium and actinide mission success not just at Los Alamos but across the NNSA Nuclear Security Enterprise (NSE).

Importantly, our goals support NNSA's desired outcomes of on-time, on-budget warhead modernization and adaptive, agile, responsive, and resilient NSE to meet evolving military and nonproliferation requirements through operational excellence and a capable and empowered workforce.



Community outreach activities like this middle school math camp in Pojoaque helps to inspire our next generation workforce

NNSA
National Nuclear Security Administration

MISSION – To protect the American people by maintaining a safe, secure, and effective weapons stockpile; reducing global nuclear threats; and providing naval nuclear propulsion

VISION – A national reputation of excellence that is responsive to the nation's nuclear security and strategic defense needs

VALUES – Integrity, Trust, Respect, Accountability, and Excellence

Los Alamos
NATIONAL LABORATORY
EST.1943

MISSION – To solve national security challenges through simultaneous excellence

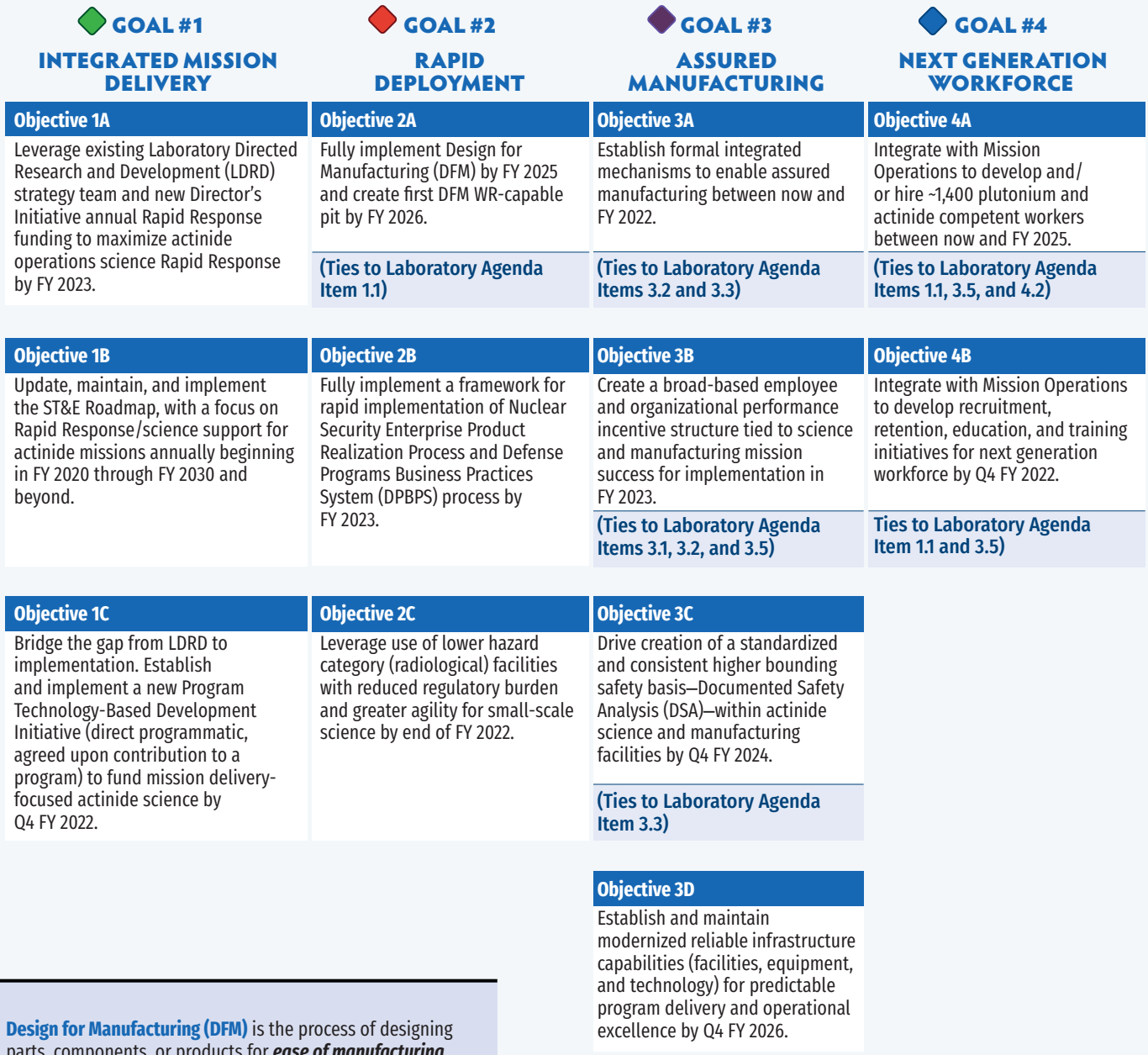
VISION – To be trusted by our nation, emulated by our peers, and respected by the world

VALUES – Service, Integrity, Teamwork, and Excellence

"LOS ALAMOS NATIONAL LABORATORY'S MAIN RESPONSIBILITY IS TO ENSURE OUR NATION'S SECURITY THROUGH NUCLEAR DETERRENCE—THIS INCLUDES STEWARDSHIP OF OUR NATION'S NUCLEAR WEAPONS TO ASSURE OUR ALLIES AND DETER OUR ADVERSARIES. THE LABORATORY APPLIES THE BEST SCIENTIFIC AND ENGINEERING SOLUTIONS TO OUR NATIONAL SECURITY MISSION AND TO MANY OF THE WORLD'S MOST DIFFICULT CHALLENGES."

– From Los Alamos Our History

Figure 3
Plutonium and actinide mission objectives



Design for Manufacturing (DFM) is the process of designing parts, components, or products for ***ease of manufacturing*** with an end goal of ***making a better product at a lower cost***. This is done by simplifying, optimizing, and refining the product design. Ideally, DFM needs to occur early in the design process and include key stakeholders—engineers, designers, operations, manufacturer, mold-builder, and material supplier—and include consideration of DOE Standard 1189, Integration of Safety into the Design Process. The intent of this "cross-functional" DFM is to challenge the design—to look at the design at all levels: component, sub-system, system, and holistic levels—to ensure the design is optimized and does not have unnecessary cost embedded in it. At Los Alamos, DFM also drives the creation of "born certified" pits through designing in ease of certification.

3

STRATEGIC ENVIRONMENT

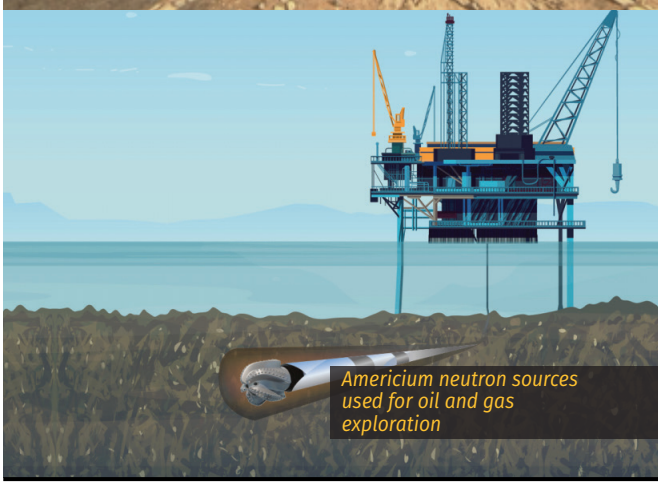
In developing our integrated initiative for plutonium and actinide missions, we recognize that our mission does not occur in a vacuum but rather in the midst of a complex and changing strategic environment. This is why our goals of integrated mission delivery, rapid deployment, assured manufacturing (including DFM), and next generation workforce are so important. They are aimed at enabling us to respond to meet the current and future needs of our dynamic environment. Los Alamos is charged by the Department of Energy (DOE) to address U.S. national needs in a number of mission areas. The breadth of actinide ST&E and manufacturing capabilities are great. Los Alamos supports weapons production for strategic ballistic missile platforms including W78, W76-0/1/2, W88, and aircraft platforms including B61-3/4, B61-7, B61-11, and B61-12 for our nation's defense for the U.S. Navy, U.S. Air Force and select North Atlantic Treaty Organization (NATO) forces. But we also support space exploration, energy exploration, nonproliferation, and foundational plutonium and actinide science.

Our missions are influenced by national priorities to:

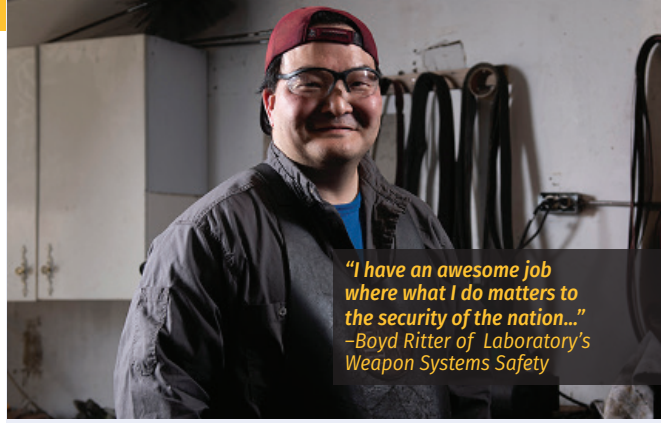
- Address challenges of aging nuclear weapons stockpile
- Achieve ramp up of pit production to 30 pits per year
- Surpass nuclear weapons capabilities of non-allied nations
- Meet the needs of U.S. space exploration
- Support global nuclear nonproliferation efforts
- Agilely address future actinide science challenges in a dynamic global environment
- Support the oil and gas industry's need for cost-effective energy exploration
- Respond to the nationwide decline in nuclear capable resources through inspiring our next generation plutonium and actinide workforce of the future

Components for air, sea, and land-based delivery systems

^{238}Pu heat sources to power NASA's Mars Exploration Rovers



Americium neutron sources used for oil and gas exploration



POLICY DIRECTION

The U.S. nuclear deterrent is vital to our national security and that of our Allied nations. Los Alamos plays a key role in the surveillance of that deterrent and the manufacturing of nuclear components in support of the NNSA's mission, including maintaining a safe, secure, and effective weapons stockpile and reducing global nuclear threats. Our plutonium and actinide missions flow directly from the security vision, directives, and requirements articulated through two core national strategy and policy documents – the National Security Strategy and Nuclear Posture Review.

National Security Strategy (NSS) (2017)—The NSS outlines the administration policies for handling the major national security concerns of the United States. The 2017 NSS is organized around four pillars guided by a return to principled realism. The NSS lays out the U.S. strategic vision for protecting the American people and preserving our way of life, promoting our prosperity, preserving peace through strength, and advancing American influence in the world. This includes renewing our nuclear capabilities under Pillar III: Preserve Peace through Strength and regaining our nuclear technology edge. Key aspects include sustaining our nuclear weapons, modernizing our nuclear weapons infrastructure, and maintaining a stable nuclear deterrent. It also outlines U.S. space strategy aspects relevant to the Los Alamos's heat source mission, including advancing space as a priority domain, promoting space commerce, and maintaining the U.S. lead in space exploration.

Nuclear Posture Review (NPR) (2018)—The NPR is the primary policy document of the U.S. nuclear enterprise. NPR describes the security environment, the roles and types of nuclear weapons the U.S. should field, and technical requirements to support the nuclear deterrent. It contains an assessment of the nuclear posture of the United States to address the evolving and uncertain international environment. The review acknowledges the continued national importance of nuclear capabilities and nuclear deterrence as a national strategy – including capacity to hedge against an uncertain future. Key initiatives outlined in this review include the provision of the enduring capability and capacity to produce plutonium pits at a rate of no fewer than 80 pits per year by 2030 (including 30 pits per year at Los Alamos) and rapid pursuit of the Stockpile Responsiveness Program established by Congress to expand opportunities for young scientists and engineers to advance warhead design, development, and production skills.

Four Pillars of the 2017 National Security Strategy

1. Protect the American people, the homeland, and the American way of life
2. Promote American prosperity
3. Preserve peace through strength
4. Advance American influence

2018 Nuclear Posture Review, U.S. Nuclear Capabilities, and Enduring National Objectives

- Deterrence of nuclear and non-nuclear attack
- Assurance of Allies and partners
- Achievement of objectives if deterrence fails
- Capacity to hedge against an uncertain future
- Modernization of our infrastructure

"THE SECRETARY SHALL INITIATE A NEW NUCLEAR POSTURE REVIEW TO ENSURE THAT THE UNITED STATES NUCLEAR DETERRENT IS MODERN, ROBUST, FLEXIBLE, RESILIENT, READY AND APPROPRIATELY TAILORED TO DETER 21ST-CENTURY THREATS AND REASSURE OUR ALLIES."

– President Donald Trump, 2017

In addition, the following documents and policy directives contain key drivers for the Los Alamos plutonium and actinide missions:

- **Fiscal Year 2020 Stockpile Stewardship and Management Plan (SSMP)**—The SSMP describes plans to ensure the safety, security, and effectiveness of the U.S. nuclear weapons stockpile and to maintain the scientific and engineering tools, capabilities, and infrastructure that underpin the Nuclear Security Enterprise.
- **Prevent, Counter, and Respond: A Strategic Plan to Reduce Global Nuclear Threats: FY 2020-FY 2023**—This annual report to Congress outlines the equally vital missions of reducing the threats of nuclear proliferation and nuclear terrorism.
- **NNSA Governance & Management Framework (2019)**—In concert with the NNSA's Strategic Vision and the Strategic Integrated Roadmap for NSE, the Governance & Management Framework lays out the path and the tools for the NNSA Team to deliver its mission in a resilient, agile, and responsive manner. The NNSA Team is comprised of the NNSA's federal program, functional and field offices, and the management & operating partners, including Triad at Los Alamos. The NNSA Team will deliver on its mission priorities that prominently include strengthening key science, technology, and engineering capabilities. Notably, this framework emphasizes responsible risk management rather than the unrealistic goal of eliminating all risk. The framework adopts a holistic and rigorous approach to risk management that addresses the concept of risk acceptance, clarifies responsibilities associated with accepting specific risks, and strikes an appropriate balance between completing the mission efficiently and meeting all regulatory standards. NNSA acknowledges that it is never a choice to either meet regulatory expectations or meet mission deliverables. Instead, all objectives must be accomplished to achieve simultaneous excellence.
- **DOE Record of Decision for the Complex Transformation Supplemental Programmatic Environmental Impact Statement (2008) – Operations Involving Plutonium, Uranium, and the Assembly and Disassembly of Nuclear Weapons**—This Record of Decision established Los Alamos as a consolidated center of excellence for plutonium – i.e., as the Plutonium Center of Excellence. Los Alamos's role as the Plutonium Center of Excellence includes services as the Design Authority for pits, the leader in plutonium research and development, and a leader in pit manufacturing.
- **Administration's FY 2021 Research and Development Priorities (2021)**—This establishes national research and development priorities including American security (including advanced military capabilities, such as nuclear deterrent capabilities), advanced manufacturing, advanced energy technologies, and space exploration and commercialization.
- **White House Space Policy Directive 1 (SPD-1) (2017)**—A White House space policy that provides for a U.S.-led, integrated program with private sector partners for a human return to the moon, followed by missions to Mars and beyond. This is supported by the National Aeronautics and Space Administration (NASA) direction on production rates/needs for ^{238}Pu heat sources – the General Purpose Heat Source (GPHS) and the Light Weight Radioisotope Heater Unit (LWRHU).

In addition, key NNSA and Los Alamos site documents include:

- **National Nuclear Security Administration Strategic Vision, December 2018**
- **Integrated Strategy for Plutonium Missions at Los Alamos National Laboratory, June 2020, LA-CP-20-20372**
- **Staffing Plan for Plutonium Missions at Los Alamos National Laboratory, June 2020, LA-CP-20-20312**

5

GOVERNANCE AND ORGANIZATION

Laboratory Director Thomas Mason and Under Secretary Lisa Gordon Hagerty dedicating new Los Alamos secure building

Our integrated initiative for plutonium and actinide missions embodies the NNSA key expectations for governance and management (see box to right). The very essence of **Laboratory Agenda Item 2.6** is to improve mission integration to effectively deliver the plutonium and actinide mission priorities working as "one Laboratory." This document will be shared with our workforce in an effort to ensure that every member of our workforce knows and understands our plutonium and actinide mission and his or her very important role in accomplishing our mission. Key elements of streamlining are included in our goals of rapid deployment and assured manufacturing. Design for Manufacturing (DFM) will also help to streamline our processes by enabling us to move seamlessly from design to manufacturing in the most efficient way. Our Stewardship Model included in *Section 7.4* provides clearly defined roles and responsibilities to ensure mission success.

We recognize that good governance fosters a common understanding of the unique relationships among all entities with a stake in the outcome. We have defined those stakeholders in *Section 7.2 and 7.4* and the relationships between them in *Section 7.4*. As shown in our Stewardship Model, our ultimate customer in fulfilling the Los Alamos plutonium and actinide missions is the NNSA–including both NNSA Headquarters and our local NNSA-Los Alamos leadership. NNSA has several end-user partners that are the sponsors of many of the products of our plutonium and actinide missions. These include the Department of Defense (DoD), NASA, DOE Office of Science (SC), DOE Office of Nuclear Energy (NE), Department of Homeland Security (DHS), and the oil and gas industry.

NNSA Key Expectations

Governance and Management of the NSE

1) Work with a single purpose as "One NNSA" through more effective teaming and improved mission integration.

2) Ensure every member of our workforce knows and understands our mission and his or her role in accomplishing it.

3) Empower leadership to streamline decision making and manage rather than avoid risk.

4) Execute the mission based on clearly defined roles, responsibilities, authorities, and accountability to prevent redundancy and miscommunication.

Recognizing that Federal and Contractor alignment is essential to effective governance, we have embodied these NNSA expectations in our integrated initiative.

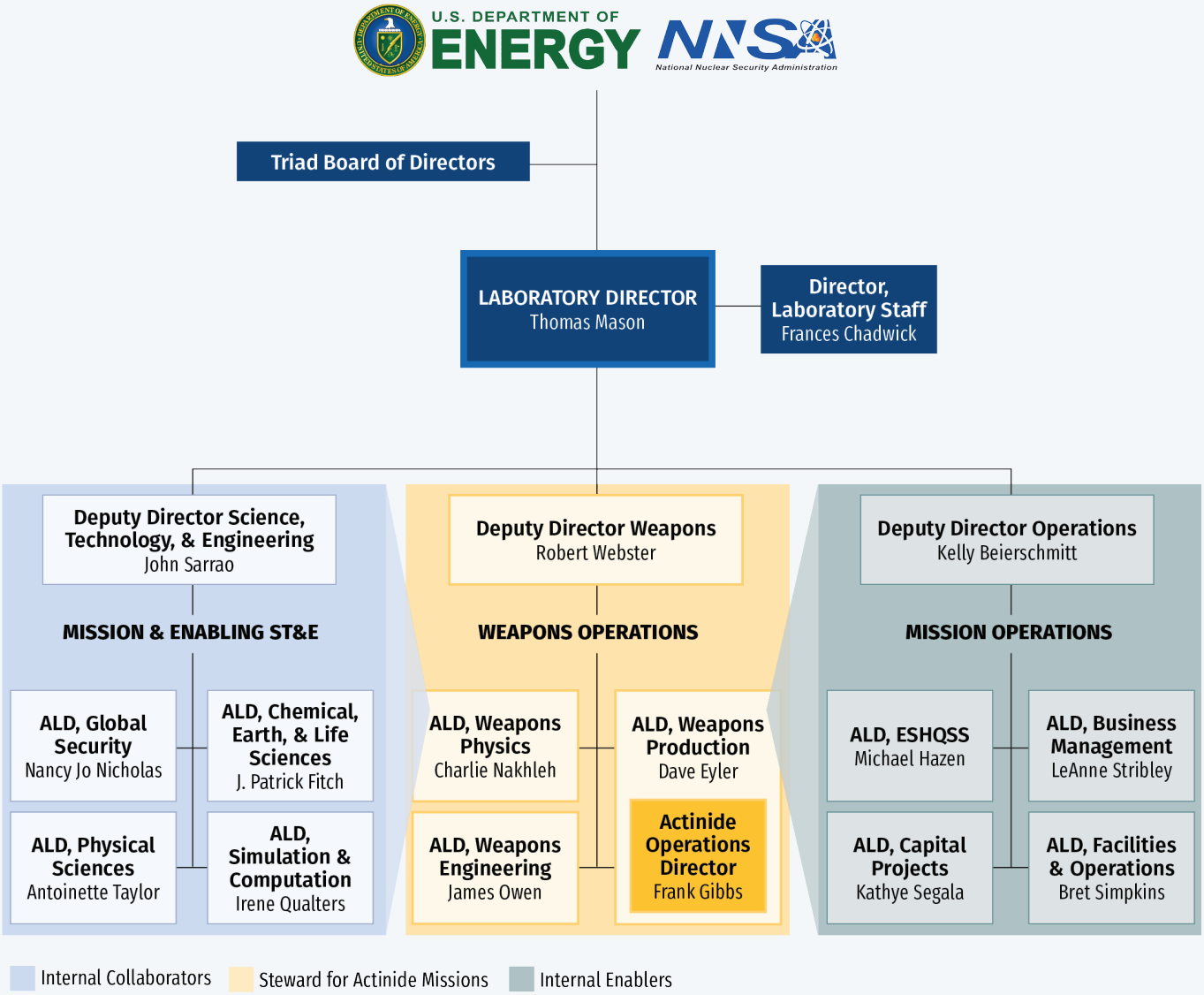
Our Stewardship Model described in *Section 7.4* includes the following elements of governance:

- Federal: NNSA Federal Oversight, NNSA Governance Steering Committee, NNSA-Los Alamos Oversight
- Triad Board of Directors
- Triad Board Committees: Finance, Audit, and Ethics; Human Resources and Compensation; Mission; Operations; and Science, Technology, and Engineering
- Actinide Mission Leadership Council
- Actinide Integrated Governance and Review Board ***NEW***

Figure 4 *on the following page* shows how the plutonium and actinide missions fit into the overall organizational structure of the Laboratory. Our Deputy Director for Weapons, Robert Webster, has responsibility for the majority of plutonium and actinide missions. As such, he is the steward of these missions responsible for shepherding the success of our eight mission areas that are described in *Section 6*. Organizationally, he reports to and is accountable to the Laboratory Director Thomas Mason who is accountable to the NNSA and Triad Board of Directors.

Direct execution responsibility for the plutonium and actinide missions are shared among Dave Eyler, Charlie Nakhleh, and James Owen, with Frank Gibbs serving as the Director for Actinide Operations. In addition, John Sarrao, Deputy Director for ST&E, has responsibility for elements of the Advanced Recovery and Integrated Extraction System (ARIES) mission, heat source mission, and americium mission. However, the success of all eight mission areas are highly dependent on the collaboration of the ST&E organization (collaborator) and day-to-day support from the Operations organization (enabler). While actinide operations report to Frank Gibbs, the plutonium pit production mission reports separately to Dave Eyler. The roles and responsibilities of the steward organizations as well as the collaborative and enabling organizations are described in *Section 7.4*.

Figure 4
Overall organizational structure of the Laboratory



6

Ronald Chavez displaying a ring of purified plutonium metal in a glovebox

MISSION AREAS AND ENABLERS

"WE MUST PUT THE MISSION FIRST TO ENSURE WE CAN MEET OUR DELIVERABLES ON TIME AND ON BUDGET IN SUPPORT OF THE NATION'S SECURITY."

–National Nuclear Security Administration Strategic Vision, December 2018

The execution of this integrated initiative for plutonium and actinide missions is built upon eight mission areas:

1. Produce plutonium pits for the nuclear weapons stockpile
2. Produce ^{238}Pu heat sources and radioisotope thermoelectric generators (RTGs)
3. Evaluate pits returned from the nuclear weapons stockpile to support annual stockpile assessments and to inform future pit designs
4. Process plutonium into forms suitable for disposition to support nonproliferation goals
5. Produce plutonium components for assembly into devices used in subcritical experiments
6. Perform fundamental science on the material properties and aging of plutonium
7. Recover americium for the DOE Office of Science
8. Conduct uranium operations in support of weapons and nuclear energy programs

The first seven mission areas listed above are aligned with the activities described in the Integrated Strategy for Plutonium Missions at Los Alamos National Laboratory (June 2020). *Sections 6.1* through *6.7* provide a summary of the current state and future objectives of each of these plutonium mission activities, with a focus on deliverables and milestones through FY 2026. *Section 6.8*, the final mission area, describes two of Los Alamos's uranium programs that support the nation's weapons and nuclear energy programs.

To meet Los Alamos's challenging plutonium and actinide mission areas, we have identified four key enablers that will help us achieve our ambitious goals:

1. Develop the plutonium and actinide next generation workforce
2. Modernize and increase the infrastructure capacity
3. Achieve operational excellence
4. Strengthen and integrate actinide ST&E and manufacturing

The NNSA Strategic Vision identifies seven strategic management challenges; we align with the first three in our enablers (workforce; infrastructure; and operational excellence, including safety and security). Our fourth enabler aligns with NNSA's Mission Priority #4 to "strengthen key science, technology, and engineering capabilities."

Our people are our most valuable resource. Hiring, training, educating, and retaining the workforce of the future is a primary activity for our success. *Section 6.9* details our plans for hiring ~1,400 people by FY 2025 to meet our mission to produce 30 pits per year by 2026.

Infrastructure at Los Alamos is aging. For example, TA-55 PF-4, the primary location of all plutonium and actinide work, was established in 1978. To ensure continuity of all missions, we must recapitalize our existing infrastructure while at the same time prioritize new construction. Priorities for infrastructure at Los Alamos are described in *Section 6.10*.

Section 6.11 describes our understanding of all the requirements for achieving operational excellence. Finally, *Section 6.12* describes our programs for developing a pipeline of scientific and technological innovation and our process for bridging technologies from development to implementation.

6.1 Mission Area #1 Produce Plutonium Pits

Pits produced at Los Alamos will be incorporated into the nuclear weapons stockpile.

A pit is the nuclear fuel inside a warhead that, when imploded with high explosives, "triggers" (initiates) a thermonuclear explosion. Plutonium pits are a key component for nuclear weapons, yet the United States' current capability to produce the pits is limited. The United States has not manufactured a war reserve pit since 2012 and has not had the ability to manufacture more than 10 pits per year (ppy) for over three decades, since the Rocky Flats Plant stopped pit manufacturing in 1989. "War reserve" refers to a component that has met all quality requirements and can be used in the nation's nuclear weapons stockpile.

Due to an evolving geopolitical landscape, the 2018 Nuclear Posture Review called for a revitalization of the pit production capability, stating that the United States must "provide the enduring capability and capacity to produce plutonium pits at a rate of no fewer than 80 pits per year by 2030." Given this imperative, the plutonium pit production mission has become one of the most important in NNSA history.

DOE/NNSA's approved plan to meet these pit production requirements is twofold: invest in Los Alamos to produce 30 war reserve ppy beginning in 2026, and repurpose the former Mixed Oxide Fuel Fabrication Facility at the Savannah River Site to produce 50 war reserve ppy by 2030.

Los Alamos is the U.S. Plutonium Center of Excellence – the nation's only fully functioning plutonium facility for research and development and currently the only pit manufacturing capability within the Nuclear Security Enterprise. The NNSA requirement for Los Alamos to deliver the first production unit (FPU) in 2023 and then ramp up to a steady-state production of 30 ppy starting in 2026 is the driver for Los Alamos's need to rapidly increase staffing and to make substantial infrastructure investments within the next 3–5 years.

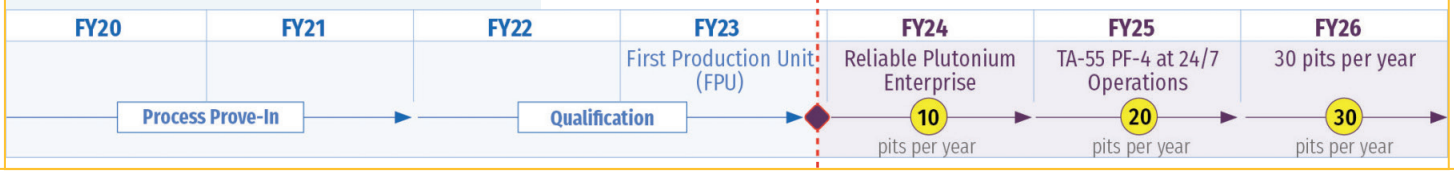
Los Alamos successfully produced 10 fully qualified—"diamond stamped"—pits in 2007-2008, and we will leverage that experience in our pit production mission as well as the expertise of personnel from the Rocky Flats Plant who are integrated into the current Los Alamos workforce. Manufacturing will be done with plutonium taken from retired pits and raw material from previous manufacturing. Once completed, pits will be delivered to the Pantex Plant in Texas for stockpile use.

Los Alamos's accomplishments to date include:

- Manufactured five development pits in FY 2019 (test new pit production processes) and delivered the plan to meet the 30 ppy mission.
- Continued aggressive hiring to meet the workforce requirements to manufacture the first war reserve pit in FY 2023. Los Alamos hired several hundred workers in FY 2020 and expects to hire approximately 1,400 additional people in the next five years. See *Section 6.9*, Develop Plutonium and Actinide Next Generation Workforce.
- Installed and deployed new equipment for every step of the manufacturing flow sheet, such as a new casting furnace, new welding equipment, and new machine tools.
- Continued investments to replace end-of-life pit production equipment and facilities required to manufacture the first war reserve pit in FY 2023. Over $6B in infrastructure line item projects will be accomplished by 2034. See *Section 6.10*, Modernize and Increase Capacity of Infrastructure.

Figure 5
Pit production schedule for 30 pits per year at Los Alamos

The timeline for meeting the 30 ppy mission is shown in **Figure 5**. Pending funding availability, Los Alamos is also evaluating options to operate concurrent development and production lines to increase the pit build rate in the future.



6.2 Mission Area #2 Produce ^{238}Pu Heat Sources and Radioisotope Thermoelectric Generators

Radioisotope power systems (RPS) are a type of nuclear energy technology that uses heat to produce electric power for operations in remote, unmanned locations. The RPS program at Los Alamos supports the National Aeronautical Space Administration (NASA) and the Department of Defense (DoD) in the production of heat sources that will eventually be assembled into radioisotope thermoelectric generators (RTGs).

RTGs are electricity generating devices that use an array of thermocouples to convert the heat released by the decay of radioactive material into electricity. Common uses for RTGs have been in satellites, space probes, unmanned remote facilities, and classified defense missions.

The two heat sources currently produced at Los Alamos for NASA include the GPHS and the LWRHU. Both heat sources enable NASA missions to have power and heat in remote and challenging environments.

Los Alamos has supported previous NASA missions: Galileo, Ulysses, Mars Pathfinder, Cassini-Huygens, Mars Exploration Rovers, New Horizons, and Mars Science Laboratory. Going forward, the planned constant rate of production at Los Alamos will support NASA's Mars 2020 (2020 launch) and New Frontiers–Dragonfly (2026 launch) missions.

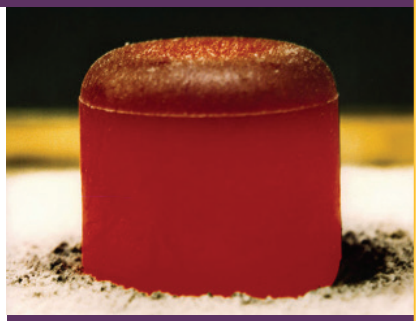
In addition to producing heat sources for NASA, Los Alamos also produces war reserve heat sources for the nuclear weapons stockpile.

The production rate for these Los Alamos heat source programs is shown in **Figure 6**. GPHS is a current production program. The LWRHU, which has a different size and design than the GPHS, is in the planning stage with production starting in FY23. The production rate for heat sources for DoD is dependent on direction from NNSA.

Los Alamos uses mostly legacy ^{238}Pu from retired warheads or new material from the Oak Ridge National Laboratory to create the heat sources, which are welded containers with ^{238}Pu on the inside. Depending on how the heat source will be used, the ^{238}Pu could be in a granular form (about the consistency of sugar, except black in color) or a ceramic pellet.

NASA heat sources use the pellet form, which requires additional processing, as a launch safety issue. By using the pellet form, the radioactive material is not dispersible in case of rocket failure. After fabrication, Los Alamos ships the NASA heat sources to Idaho National Laboratory for storage and eventual assembly into an RTG.

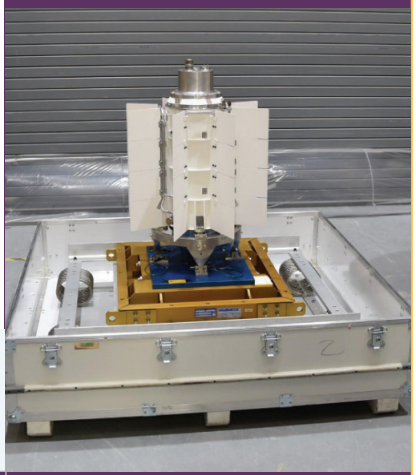
For DoD heat sources, the plutonium is kept in the granular form, triple encapsulated, and then assembled into RTGs in PF-5. The RTGs are then shipped to the Pantex Plant in Texas for use in classified defense missions.



Plutonium-238 heat source pellets are manufactured at Los Alamos.

The ^{238}Pu GPHS pellet is encapsulated at Los Alamos.

An RTG, shown above, is assembled at Los Alamos, and shipped to the Pantex Plant in Texas for final integration into the desired product.



The Perseverance Multi-Mission Radioisotope Thermoelectric Generator, seen here before fueling and testing at DOE's Idaho National Laboratory, is powered by plutonium oxide produced at Los Alamos.

Photo courtesy NASA/JPL-Caltech

Figure 6
Plutonium production rates by program

Heat Source	FY20	FY21	FY22	FY23	FY24	FY25	FY26
GPHS for NASA (certify/fabricate)	10/15	10/15	10/15	10/15	10/15	10/15	10/15
LWRHU for NASA	0	0	0	12	16	10	10
Heat sources for RTGs for DoD	Production rate per NNSA direction						

6.3 Mission Area #3 Evaluate Pits Returned from the Stockpile

The U.S. nuclear stockpile is evaluated annually, and components of the strategic weapons are individually tested to ensure their viability and functionality in the event the President of the United States decides the weapons are required for use.

As part of this annual stockpile assessment, Los Alamos evaluates pits, RTGs, and other components of the active nuclear weapons stockpile to assess their performance, reliability, and safety. This process takes place at Los Alamos's TA-55 for pits (the nuclear trigger) and RTGs (a plutonium-based electrical component). Elsewhere at the laboratory, detonators, valves, actuators, and other structural components are independently tested.

TA-55 is the hub of plutonium and actinide operations at Los Alamos, including analysis of pits and RTGs returned from the stockpile for evaluation.

Pits and RTGs are evaluated nondestructively (e.g., radiography, mass, photography, weld and braze evaluation, and dimensional inspection) for aging and materials issues of consequence prior to disassembly and destructive evaluation (e.g., metallographic evaluation of welds and brazes, tensile strength, dimensional inspection, interfacial degradation evaluation, and chemical composition).

The resultant data set is integrated and evaluated before an annual certification is issued by the Laboratory Director to the President of the United States on the continued effectiveness of the nation's nuclear stockpile. The data are also used to support decisions regarding weapon life extensions, alterations, modifications, repairs, rebuilds, legacy pits in staging at Pantex, and future pit designs.

The aging of the nation's nuclear stockpile, and the radiological materials and environment in which these components are held, potentially result in materials aging, corrosion, and fatigue situations that would alter the effectiveness of the stockpile. Utilizing the best competency in actinide science and engineering, the consequence of these natural aging phenomena are evaluated, tested, and interpreted in determining the viability of the nation's nuclear stockpile.

Several weapons from each system are selected annually to be disassembled and inspected. The pits from each of the dismantled weapons are nondestructively inspected at Pantex. Los Alamos uses that inspection data combined with the original build records from the Rocky Flats Plant to determine which pits to further destructively evaluate. Those selected units are disassembled for destructive evaluation and Los Alamos completes a final report on all the results of the data at pit surveillance completion. Other testing, such as full-scale gas transfer tests, are performed on an as-needed basis.

Los Alamos also destructively evaluates RTGs returned from the nuclear weapons stockpile during the annual assessment. In addition, Los Alamos annually evaluates the performance of RTGs in a shelf-life program. Shelf-life program testing includes an electrical evaluation, while destructive testing consists of several evaluations, including electrical, gas sampling, and materials characterization. Similar to pit surveillance, other testing can be perfromed on an as-needed basis. **Figure 7** provides activity levels for both pit and RTG surveillance from FY 2020 to FY 2026.

The annual assessments not only ensure the safety and reliability of current weapons, but also informs future pit designs. For example, if pit surveillance started showing a trend related to a particular feature or design style (e.g., it is not aging expectedly), then future design systems might not use that design style or it would modify the design so it is less susceptible to the problems seen during the surveillance program.

Figure 7
Key deliverables for pit and RTG surveillance through FY 2026

Program	Deliverable	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Pit Surveillance	Full-scale Gas Transfer Tests	2	4	4	3	1	4	5
	Pit Disassemblies	6	8	12	8	6	6	11
	Pit Completions/Reports	2	11	10	9	7	8	10
RTG Surveillance	Destructive Tests	12	12	12	12	10	10	12
	Shelf-life Evaluations	97	96	108	119	130	141	152

6.4 Mission Area #4 Process Plutonium in Support of Nonproliferation

From supporting the United States in counter terrorism and counter proliferation, to actively transforming plutonium pits to plutonium oxide for disposal, Los Alamos plays a major role in our country's global security.

Because of our deeply rooted and foundational understanding of the nuclear materials of concern (commonly known as the actinides), and our thorough understanding of production technologies and special nuclear material measurement, Los Alamos is called on to provide subject matter experts and technical advice on emerging radiological and nuclear threats, and analysis of foreign and transnational actor capability and inventories. Los Alamos also provides leadership in detection, mitigation, and consequence management where nuclear materials are involved. TA-55 is one of the only places in the country where special forensics techniques and functions tied to nuclear material are provided to the FBI and the Department of Justice, when requested.

Analysis of plutonium oxide is a key capability in support of Los Alamos's nonproliferation missions.

For example, if special nuclear material is intercepted, Los Alamos would be called upon to advise how to handle the material so it does not explode, and how to deactivate the device, or safely move it so it can be analyzed. Los Alamos works with law enforcement, who would maintain custody of the nuclear material, to help figure out who built the device or where the material came from. If a weapon is discharged, Los Alamos can reverse-engineer the weapons design and help identify the actor (conduct "post-detonation forensics"). For anything related to plutonium or related special nuclear material, TA-55 is the only place in the United States where these tests are currently authorized.

In addition to supporting counter terrorism and counter proliferation, Los Alamos takes an active role in transforming plutonium pits to plutonium oxide for disposal. On September 1, 2000, the United States and Russia committed to each "permanently dispose" of 34 metric tons of weapons-grade plutonium—enough plutonium to make thousands of weapons. To help meet this commitment, the Department of Energy (DOE) announced a strategy for the permanent disposition of U.S. surplus weapons-grade plutonium, which requires destroying thousands of surplus plutonium pits. When older versions of weapons are retired from the nuclear arsenal, the weapons are disassembled and their plutonium pits, which trigger their nuclear explosion, are removed, and staged at the Pantex Plant in Texas.

Plutonium pits remain in interim staging at Pantex until they are processed for permanent disposal. Los Alamos is the only place in the nation capable of disassembling these pits and transforming them into a proliferation-resistant powder. The process for transforming pits to plutonium oxide was developed at Los Alamos as a pilot project called the Advanced Recovery and Integrated Extraction System (ARIES).

The ARIES process requires specialized personnel, equipment, and facilities. First, the pits are cut into manageable pieces inside gloveboxes using an automated, custom-made mill and lathe, along with custom cutting tools. After dismantling, the pit's plutonium parts and pieces are rapidly oxidized into plutonium oxide inside a custom furnace. After oxidation, the plutonium compound is ground and mixed with products from other pits into a powder. The powder is sealed inside a special stainless-steel container suitable for long-term storage and packaged to meet stringent safety and security requirements for shipping. The plutonium oxide is then shipped to SRS, where it is diluted and prepared for disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico.

Figure 8 provides Los Alamos's oxide production for plutonium disposition from FY 2020 through FY 2026.

Figure 8
Key deliverables for plutonium oxide production

Program	Deliverable	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Plutonium Disposition	Plutonium oxide (kg)	100	160	350	390	440	500	500

6.5 Mission Area #5 Produce Plutonium Components for Subcritical Experiments

Los Alamos produces plutonium components for use in subcritical experiments (SCEs) designed to assess the safety, security, and effectiveness of the U.S. nuclear stockpile. In the absence of underground nuclear explosive testing, modeling the complexity of our nuclear weapons systems is essential to ensuring that the nuclear weapons stockpile is safe, secure, and reliable. A key Los Alamos actinide mission priority is successfully casting, machining, and fabricating plutonium components to SCE design requirements.

Shown is the next generation Fisheye Probe of the DOE's 2012 R&D 100 Award winning Multiplexed Photonic Doppler Velocimeter technology. This diagnostic system was developed in a partnership between Los Alamos, Lawrence Livermore National Lab, and National Security Technologies, LLC. The technology measures the position of a SCE component at unprecedented temporal and spatial resolution, allowing scientists to watch a device surface as a function of time and position as it implodes. These data are then compared to the model generated by the design community to determine if the model is accurately reproducing the implosion behavior of the assembly components.

Of currently applied sources of information for the stockpile assessment, properly designed, assembled, and diagnosed SCEs provide the most realistic physics conditions short of nuclear testing. These integrated experiments involve the use of high-explosive detonations o drive special nuclear material components to weapon-relevant conditions in order to characterize its response. SCEs provide the data that are essential to validating models within multi-physics design codes for predicting nuclear weapon performance. Data from SCEs are fed back to design teams, informing them whether the tested implosion produced the expected conditions and if the models predicted the observed imploded configuration.

All plutonium components used in SCEs are designed, fabricated, and assembled at Los Alamos, where almost all the country's plutonium processing occurs. Once fabricated, Los Alamos assembles these plutonium components into "ready to ship" device subassemblies that will be used in the SCEs, which are conducted at the Nevada National Security Site (NNSS). For example, Los Alamos's current Red Sage SCE program requires the production of large plutonium plates, which are assembled into SCE device subassemblies that include everything except the high explosive component. The high explosive component is added to the subassemblies at the NNSS Device Assembly Facility.

Los Alamos currently supports two plutonium component programs in FY 2020 (Red Sage and Excalibur). Additional planned programs include Durandal (FY 2021), Arondight (FY 2023), and Tizona (FY 2025). Each program requires different components, depending on the designed experimental configuration. A schedule for SCE device subassembly shipments to NNSS for FY 2020 through FY 2026 is shown in **Figure 9**.

In a long-standing collaboration between Los Alamos National Laboratory and Sandia National Laboratories (SNL), Isentropic Compression Experiments (ICEs) and other high-strain rate and high-pressure experiments have been conducted on the SNL Z-Machine platform. This collaboration is enabling the exploration of plutonium materials equation of state and mechanical properties necessary to validate, test, and improve multi-physics models and weapons simulation codes. These SCEs and ICEs are essential Stockpile Stewardship projects.

Figure 9
SCE device subassembly shipments from Los Alamos through FY 2026

SCE Device Subassembly Shipments	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Red Sage	1	2	-	-	-	-	-
Excalibur	-	-	-	2	3	-	-
Durandal	-	-	-	-	-	3	-

6.6 Mission Area #6 Perform Fundamental Science on Plutonium Materials Properties and Aging

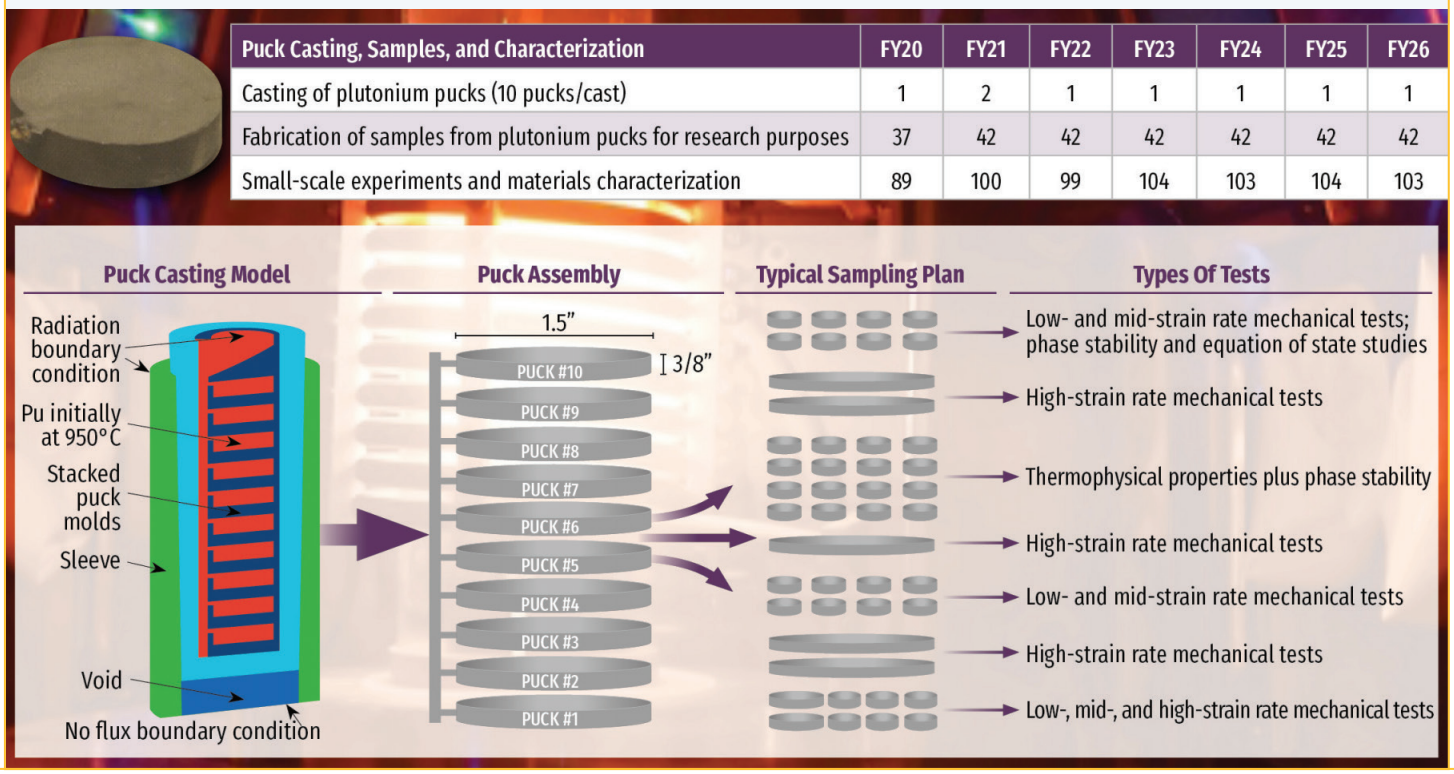
Understanding the fundamental science of the material properties and aging of plutonium is essential for ensuring the safety, security, and effectiveness of the U.S. nuclear stockpile. In the absence of nuclear testing, discontinued in the U.S. in 1992, we must rely on science and technology for assessing an aging nuclear weapons stockpile.

Plutonium, as a radioactive element, is constantly undergoing a radioactive decay process, or "aging," that results in plutonium structural changes. The decay process generates impurities, such as uranium and helium; releases energy; and induces point defects and other structural changes leading to underlying property changes, e.g., the stability of its microstructure, corrosion response, crystal structure, etc.

Fundamental science informs our understanding of the relationship between materials processing and its resultant structure. Los Alamos conducts small-scale experiments to establish the properties of a material structure and validate material models. Small-scale experiments provide extremely important data needed to validate "age aware" materials models to be used in multi-physics performance simulations. These data include, but are not limited to, thermodynamic and microstructural properties, alloy phase stability and component dimensional stability, low- to high-strain rate mechanical properties, hostile environment response, and corrosion response.

As the nation's Plutonium Center of Excellence, Los Alamos has been a leader in experimental and theoretical investigation of the material properties and aging of plutonium, from casting plutonium into puck-shaped machining stock, to fabrication of the pucks into samples for research purposes, characterizing these materials, and conducting a range of small-scale experiments. **Figure 10** provides the activity levels for puck casting, sample fabrication, and small-scale experiments and materials characterization studies for FY 2020–FY 2026, and a schematic of the casting process, including the types of tests commonly performed. Data collected from fundamental science experiments provide prevailing baseline information against which to compare similar experiments on materials from site-return components and other source materials. These small-scale experiments are essential to pit manufacturing, pit surveillance, and other stockpile stewardship programs.

Figure 10
Fundamental science on plutonium at Los Alamos through FY 2026



Puck Casting, Samples, and Characterization	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Casting of plutonium pucks (10 pucks/cast)	1	2	1	1	1	1	1
Fabrication of samples from plutonium pucks for research purposes	37	42	42	42	42	42	42
Small-scale experiments and materials characterization	89	100	99	104	103	104	103

6.7 Mission Area #7 Recover Americium

Los Alamos employee, Richard Salazar, completes the aqueous processing and packaging for transport of ^{241}Am oxide.

The goal of the Los Alamos Americium Oxide Production program is to separate and recover ^{241}Am from the pyrochemical residues that result from aged site-return plutonium purification operations. The ^{241}Am is then converted to an oxide. Production of americium oxide at TA-55 PF-4 is managed within the Los Alamos Isotope Program for the DOE-SC Isotope Program (**Figure 11**).

Americium is a key radionuclide used by the petroleum industry for oil well logging. Sealed sources used for this application are primarily americium-beryllium neutron sources. When exploring for oil or gas, well logging operations are conducted to predict the ability of a well to produce. This prediction is based on the evaluation of the geological formation and the formation parameters, such as density, porosity, permeability, and the presence and type of hydrocarbons. Americium oxide has other important uses in smoke detectors, agricultural and industrial moisture gauges, and research and development.

The primary supply of americium oxide for the oil and gas industry currently comes from Russia. The recent establishment of a domestic production capability at Los Alamos is essential for mitigating this dependence on foreign supply and ensuring availability of this isotope for energy security needs.

In FY 2018, TA-55 produced the first batches of ^{241}Am in the United States since 1984. The americium oxide material has been certified to meet the industrial user specification. Procedures are in place to ship this product to industrial end users.

Los Alamos continues to utilize our strength in actinide science to optimize americium oxide production operations. Studies are ongoing to optimize the purification steps or simplify the chemistry flowsheet when the incoming feed items are suited to an abbreviated process. This information will be used to lower production costs and increase production throughput in the future for this important industrial isotope.

In addition to evaluating how to increase the throughput for americium, Los Alamos is also looking at ways to reduce the costs of americium production to make it more economically feasible. Los Alamos is also evaluating americium's potential use in RTGs because americium, like plutonium, produces heat during its decay process and may result in better product efficiency, faster production, and/or greater economic feasibility than other RTGs.

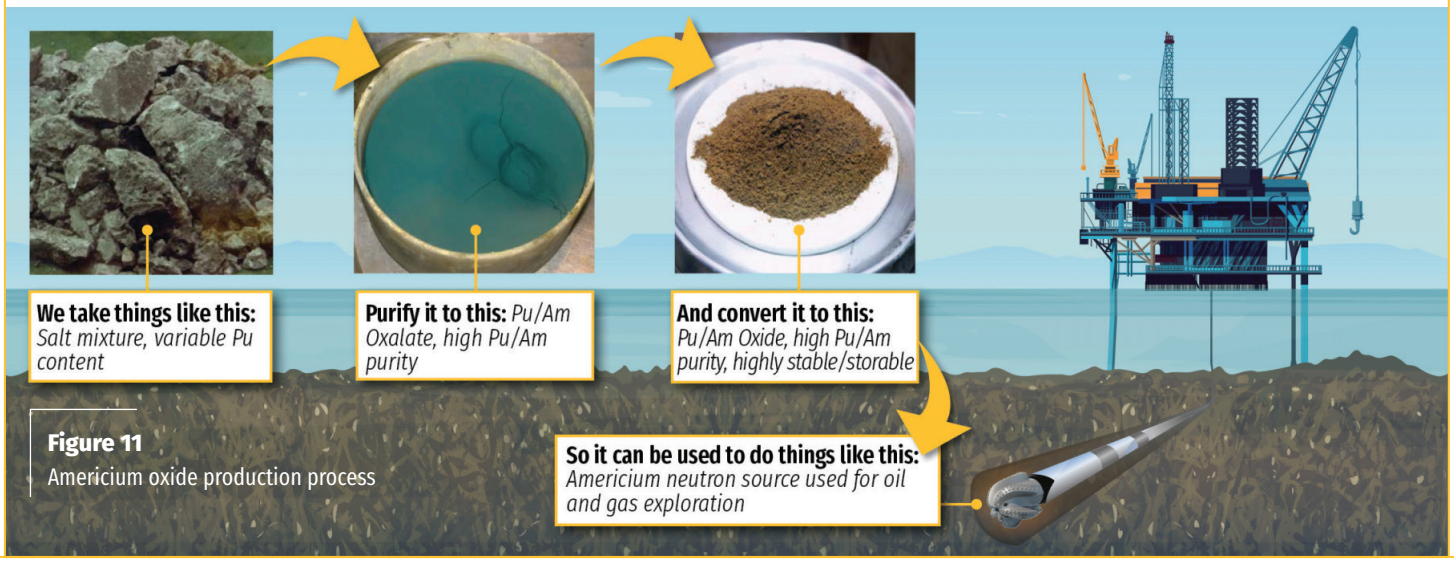


Figure 11
Americium oxide production process

6.8 Mission Area #8 Conduct Uranium Operations

Uranium is a strategic national defense asset with different assays and enrichments, including depleted uranium, low-enriched uranium (LEU), and highly enriched uranium (HEU). Uranium has a variety of defense and nuclear nonproliferation applications, including weapon components, fuel for naval reactors, fuel for commercial power reactors, and fuel for commercial and research reactors that produce medical isotopes and tritium.

Y-12 is the nation's Uranium Center of Excellence and home to its primary uranium processing and storage infrastructure. Los Alamos dispositions excess or recycled HEU and depleted and natural uranium to the Y-12 site.

HEU is uranium in which the concentration of the fissile isotope, ^{235}U, is increased to 20 percent or greater. LEU's concentration is such that its main application is for nuclear reactors; typical commercial reactors use uranium enriched to 3 to 5 percent ^{235}U.

Depleted uranium is a byproduct of the enrichment process that has a lower ratio of ^{235}U to ^{238}U than naturally occurring uranium. NNSA has a long-term requirement for high-purity depleted uranium feedstock to meet national security needs. The capability to produce, process, and handle depleted uranium supports a number of key missions within the Nuclear Security Enterprise, from providing parts for weapon life extension programs (LEPs) to downblending HEU to LEU.

A worker at Los Alamos removes uranium from an annealing treatment furnace.

Los Alamos employees load uranium metal into a casting furnace.

Uranium at Los Alamos

Two uranium-related efforts at Los Alamos are:

- The Advanced Recovery and Integrated Extraction System (ARIES) is where pits removed from the active nuclear weapons stockpile are disassembled and dispositioned. One byproduct of the disassembly process is HEU material, which is decontaminated from plutonium and shipped to Y-12 for long-term management.
- The Sigma complex at Los Alamos has an active inventory of about 40,000 kg of uranium, almost entirely depleted uranium that is in continuous use and is recycled as appropriate. Sigma is the uranium casting and processing R&D facility supporting Y-12. Sigma fabricates high density metals, including uranium, for hydrodynamic testing and SCE preparation confirmatory tests.

6.9 Enabler #1 Develop Plutonium and Actinide Next Generation Workforce

Los Alamos, like other sites in the nuclear weapons complex, has an aging workforce with weapons knowledge and experience. At the same time, our demand for skilled labor is increasing, largely due to the need to produce 30 ppy. Filling positions is a particular challenge due to the prior experience and/or technical background required; the need for security clearances; and our aging infrastructure, which can hinder effective recruitment.

To support current plutonium and actinide missions, operate Building PF-4 at TA-55 on a 24/7 basis, and produce 30 ppy by 2026, Los Alamos will hire a wide variety of workers including science/engineering technical staff, administrative/professional, operator/technician, manager/supervisor, and craft and subcontractor personnel between now and FY 2025 as shown in **Figure 12** *below*. Staffing plans call for an increase of about 1,400 personnel from FY 2020 through FY 2025.

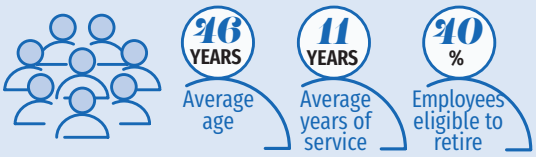
In addition to permanent staff shown in **Figure 12**, Los Alamos will hire a large interim workforce to complete the many infrastructure investments required to support the actinide missions at Los Alamos. These infrastructure needs are driven primarily by the need to establish a production capability of 30 ppy.

Workforce is listed as one of seven strategic management challenges that required immediate attention in the 2019 NNSA Strategic Vision document. To meet this challenge, Los Alamos is aggressively recruiting and developing staff and initiating targeted recruitment and retention programs to actively support the growth of our next generation workforce. **Figure 13** *on the following page* shows the workforce development activities planned through FY 2026 from early community outreach and pipelining through the entire employment cycle. In coordination with the Lab Agenda 4.2 team, we will work with the Partnerships & Pipeline Office (PPO) to ensure integration with PPO programs.

Figure 12
Staffing plan for Los Alamos's plutonium and actinide workforce through FY 2026

Estimated FTEs for All Plutonium Programs	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Execute Current Missions	2,090	2,646	2,679	2,727	2,733	2,745	2,745
Operate TA-55 PF 4 (24/7)	31	93	164	336	347	547	547
Produce 30 ppy	-	-	13	127	131	272	272
TOTALS	**2,121**	**2,739**	**2,856**	**3,189**	**3,211**	**3,563**	**3,563**

Los Alamos's Workforce*



9,410 EMPLOYEES

**Numbers are for regular/term employees and do not include craft, postdoctoral researchers, students, or others*

Recruitment and Hiring – ramping up to meet the hiring needs at Los Alamos

- New hiring center established in Los Alamos
- Large-scale hiring fairs with on-the-spot offers
- Dual career hiring assistance to support the employment of a candidate's spouse or partner
- Hire-on incentives–enhanced relocation, sign-on bonuses, environmental pay, shift-differential pay, retention bonuses
- Collaboration with educational institutions to offer pipeline programs for high school, undergraduate, and graduate students, and postdoctoral researchers; conversion of students and postdoctoral researchers to staff is the most highly utilized early-career pipeline for recruiting Los Alamos staff
- Changes to the hiring process that reduce the average time-to-hire from 5 to 6 months to 60 days or less

Increasing Retention – lowering the attrition rate through monetary and non-monetary rewards

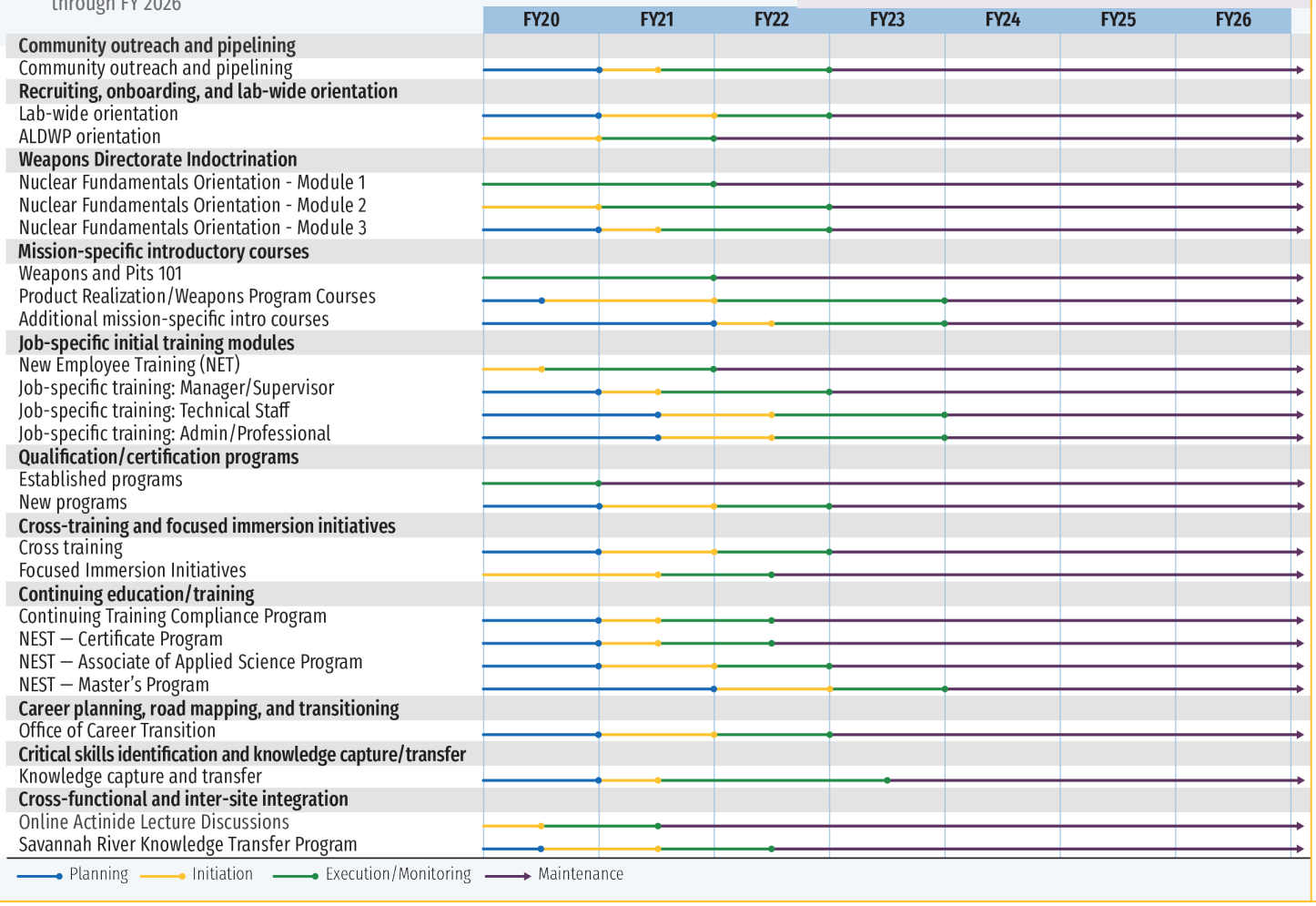
- Develop and target meaningful total rewards programs that include combinations of incentive pay, promotion, base pay, and benefits
- Development opportunities, including opportunities for cross-team projects, learning opportunities, mentorship, and internal career paths
- Flexible structures to allow additional incentives aligned to performance and desired outcomes, such as awards programs, and retention bonuses for critical skill areas

Beginning in fall 2020, Los Alamos National Laboratory is partnering with the New Mexico Building and Construction Trades Council and Taos High School to train the next generation of building trades workers for jobs with starting salaries as high as $72,000 annually.

Education and Training – integrated worker training program from new-hire to subject matter mastery

- Nuclear Fundamentals Orientation–a three-module introduction to nuclear weapons fundamentals.
- New Employee Training Academy–piloted in January 2020, this six-month program is a staple for new-hire operators/technicians, providing Fissionable Material Handler (FMH) certification and Glovebox Operator (GBO) qualification in half the previous time in a higher-quality learning experience.
- Nuclear Enterprise Science & Technology (NEST)–educational program to pilot in FY 2021 in partnership with the University of New Mexico-Los Alamos. Options exist for 1-year academic certificate or 2-year Associate of Applied Science degree. Courses will be developed and taught by Los Alamos subject matter experts in plutonium science, engineering, and manufacturing and address operational and technical issues relevant to pit production.

Figure 13
Workforce development activities through FY 2026



6.10 Enabler #2 Modernize and Increase Capacity of Infrastructure

The Radiological Laboratory, Utility, Office Building (RLUOB) contains laboratories for analytical chemistry and materials characterization of special nuclear material, along with spaces for offices and training.

Modernizing and increasing the capacity of infrastructure at Los Alamos is driven by the mission to produce 30 ppy by 2026 as well as the fact that Los Alamos has an aging infrastructure. The average age of buildings at Los Alamos is 40 years. TA-55 PF-4, the building where pit production will occur, was commissioned in 1978 and is 42 years old. Investments in new buildings, equipment, and infrastructure upgrades required to produce 30 ppy while delivering on the other plutonium missions are estimated at approximately $6B through 2034.

PF-4 is the hub of the actinide-processing facilities at Los Alamos, but there are many additional key support facilities related to actinide missions. Support facilities range from those that can process large amounts of nuclear material (Hazard Category 2 and 3 buildings) to radiological buildings and "cold" (non-radiological) facilities. Hazard Category 2/3 buildings include the Chemistry and Metallurgy Research (CMR) Building; Waste Characterization, Reduction, and Repacking Facility (WCRRF); Radioactive Assay Nondestructive Testing (RANT), the Laboratory's TRU waste shipping facility; Radioactive Liquid Waste Treatment Facility (RLWTF); and Low-Level Radioactive Liquid Waste Treatment (LL-RLW) facility. Radiological buildings include the Materials Science Laboratory; Sigma Facility; Shops Annex; Target Fabrication Facility; Global Security Laboratory; Radiochemistry Facility (RC-1); Radiological Laboratory, Utility, Office Building (RLUOB); and Occupational Health Laboratory.

Actinide missions require various infrastructure support facilities. Facilities that support personnel (parking, office, training) and manage facility byproducts (waste) provide a robust operational infrastructure. Facilities that supply analyses (chemical or materials), components (molds, materials, or tooling), and technology (development or testing) provide a robust programmatic infrastructure.

In addition to smaller infrastructure improvements and upgrades scheduled in most of the existing buildings at Los Alamos, the successful completion of several new facilities is required to support Los Alamos's current actinide missions, including the 30 ppy mission.

Four ongoing construction projects, described in **Figure 14,** enable pit production and other plutonium missions at Los Alamos. As mission plans evolve, construction projects will be updated, as necessary, to align with current site objectives.

The NNSA requirement for Los Alamos to deliver the FPU in 2023 and then increase capacity to a steady-state production of 30 ppy starting in 2026 is the driver for the Laboratory's need to rapidly increase staffing and to make substantial infrastructure investments within the next 3–5 years. To execute all scope on schedule, Los Alamos must expand the hours of TA-55 PF-4 availability as soon as possible. Extended hours would enable maintenance and construction work to be performed during off-shifts to allow the day shift to focus on programmatic activity. Beginning in 2019, Los Alamos started to transition TA-55 PF-4 for 24/7 operations, with the planned completion no later than 2024.

Figure 14
Current projects for new infrastructure to support plutonium missions at Los Alamos

Project Descriptions	Activity/Facility
Establishes the infrastructure to consolidate and modernize mission-critical analytical chemistry and materials characterization at TA-55	REI2 RLUOB Laboratories
	RC3 RLUOB Laboratories and Upgrades
	TA-50 Parking
	TA-35 Office
	TA-55 West Vehicle Access
Provides additional equipment and infrastructure to produce 30 ppy	TA-55 West Entry Control Facility
	TA-48 Training
Upgrades the TA-55 fire protection system installed in the 1970s	TA-55 Fire Alarm System Upgrades
Provides new Hazard Category 3 nuclear facility designed to treat 29,000 liters of liquid TRU waste per year	TRU Liquid Waste Facility

6.11 Enabler #3 Achieve Operational Excellence

At Los Alamos, the majority of work in which significant quantities of nuclear materials are used takes place within a Security Category 1, Hazard Category 2 nuclear facility (TA-55 PF-4) that is bounded by a regulatory environment, or legal framework, that has evolved incrementally over time.

The goals of this regulatory envelope at Los Alamos are to ensure successful and compliant execution of programs using nuclear facilities; ensure all relevant requirements are met to generate timely and cost-effective quality products; secure the nuclear materials and information; and, provide for the safety of the workforce and the environment. Successful execution and operational excellence, as defined in NNSA's Governance & Management Framework (2019), lie at the intersection of all applicable program and regulatory requirements.

While safety and security requirements are primary at any nuclear facility, to achieve operational excellence of the science, technology, engineering, and manufacturing activities at Los Alamos, they are only a part of the regulatory envelope within which programmatic work takes place. As shown in **Figure 15** *on the following page*, all mandated requirements affect and impact the ability to perform mission work. Since process operations can only be accomplished by meeting all the requirements, they thus occur at the intersection or overlap at the center (depicted in red in **Figure 15**).

Our next generation workforce is tasked with delivering operational excellence.

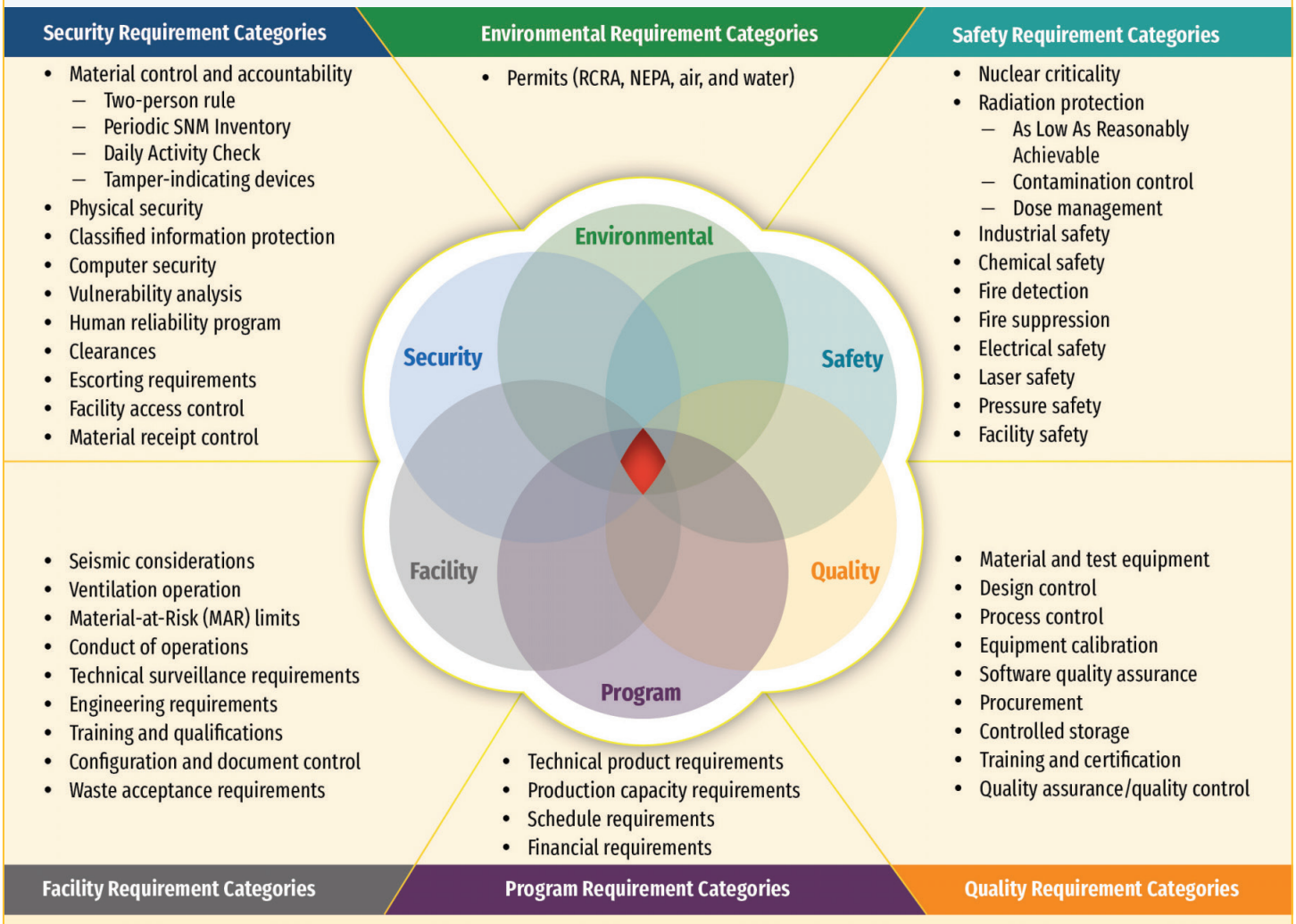
"SOME PERCEIVE SAFETY AND SECURITY AS COMPETITORS FOR MISSION ACHIEVEMENT; WE REJECT THIS PERCEPTION. INSTEAD, WE BELIEVE SAFETY AND SECURITY ARE ENABLERS TO MISSION SUCCESS. WE UNDERSTAND THAT DECREMENTS IN SAFETY AND SECURITY IMPART RISKS TO ACHIEVING MISSION."

–National Nuclear Security Administration Strategic Vision, December 2018

The number of regulations and requirements has steadily increased over time, resulting in escalating costs of compliance or concurrently a reduction in productivity. Regulations and requirements are often established independently of the resources or funding necessary to execute them. They tend to be interpreted differently by various oversight organizations within Los Alamos, at the NNSA, and at other regulatory agencies, resulting in compliance challenges. Regulations and requirements often are in direct conflict with each other since they tend to be derived independently and imposed externally, but they are integrated and executed locally within the processing facility. Such interpretations can also lead to inefficiencies that result in increased costs and reduced productivity.

Performing operations in a nuclear facility is the art of opening the bounding regulatory envelope to what is both technically and legally possible in achieving the maximum work flux, or activities accomplished per unit of time. The appropriate application of risk management leads to successfully meeting mission deliverables while achieving mission excellence.

Figure 15
Nuclear facility regulatory envelope



6.12 Enabler #4 Strengthen and Integrate Actinide Science, Technology, Engineering, and Manufacturing

Los Alamos has a strong history of integrating actinide ST&E and manufacturing. The Los Alamos Laboratory, then known as Project Y, was a secret laboratory established by the Manhattan Project and operated by the University of California during World War II. Its mission was to design, build, test, and assist in delivering the first atomic bombs, which it successfully accomplished between April 1943 and August 1945. From those origins, Los Alamos is now recognized as the nation's Plutonium Center of Excellence and remains one of the premier institutions in the world for plutonium R&D and actinide science.

Among other mechanisms, the Glenn T. Seaborg Institute (GTSI) and Los Alamos's Laboratory Directed Research and Development (LDRD) program support the maintenance and enhancement of U.S. capabilities in actinide science and technology. GTSI funds summer graduate research fellowships and postdoctoral fellowships supporting researchers interested in actinide science, radiochemistry, and heavy-element science relevant to Los Alamos's missions. Historically, up to 30 percent of these GTSI Postdoctoral Fellows will become actinide researchers, scientists, and engineers at Los Alamos.

In 1992, Congress authorized Los Alamos and the other national laboratories to initiate LDRD to foster a research environment conducive to scientific innovation and provide critical financial support necessary to execute world-class science and engineering. Many of the Laboratory's most exciting innovations—from energy security to large-scale infrastructure modeling and from actinide science to nuclear nonproliferation and detection—can be traced to early LDRD investment through the Mission Foundations Research (MFR) initiatives.

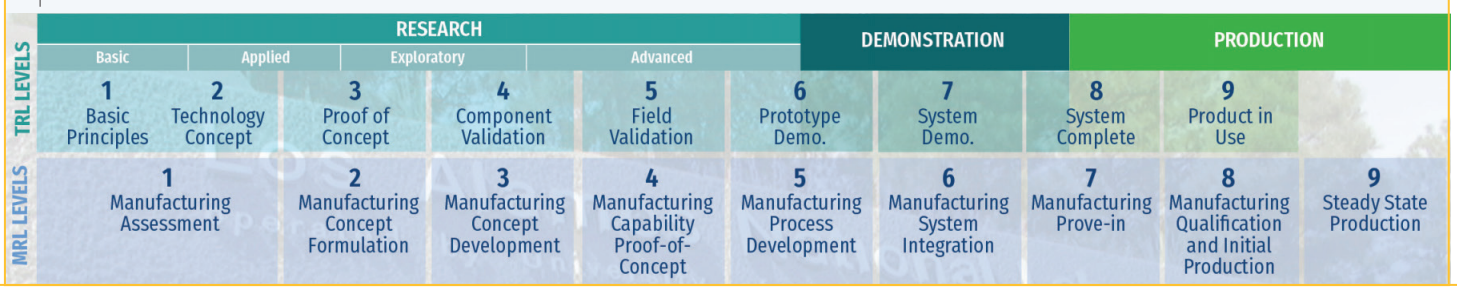
Programs such as GTSI and LDRD continue to develop the pipeline of scientific and technological innovation and workforce development at Los Alamos. With the recent NNSA directive for Los Alamos to produce 30 pits per year by 2026, there is a renewed and focused commitment to integrating ST&E with manufacturing.

For example, in August 2019, Los Alamos published its process for assessing manufacturing readiness for pit production (Pit Realization Process Manufacturing Readiness Assessments, August 27, 2019), which defines the Laboratory's process for evaluating the pit manufacturing processes using familiar tools, such as Technology Readiness Levels (TRLs) and Manufacturing Readiness Levels (MRLs), that have been developed to support a high probability for success as processes mature toward production. This document also outlined the pathway for new technology and development within the manufacturing processes.

TRLs are used to estimate the maturity of technologies as they develop from basic scientific principles to final product; MRL is a measurement scale for evaluating and defining manufacturing maturity and risk. Manufacturing processes mature as the product technology and product designs stabilize. The integration of TRL and MRL helps support DFM objectives through the design of parts, components, and products that take into consideration ease of manufacturing. An example of the interrelationship of the TRL and MRL processes at Los Alamos for pit production is shown in **Figure 16**.

Strengthening and integrating actinide ST&E and manufacturing at Los Alamos will be further enhanced by the FY 2021 formation of the Actinide Integrated Governance and Review Board (AIGRB). Its responsibilities will include informing actinide LDRD calls and mission statements in support of actinide production-oriented return on investment, championing technical and manufacturing maturation projects (TRL/MRL 6-9), and vetting and ratifying key technical decisions, as further described in *Section 7.2*.

Figure 16
Progression through technology and manufacturing readiness levels at Los Alamos



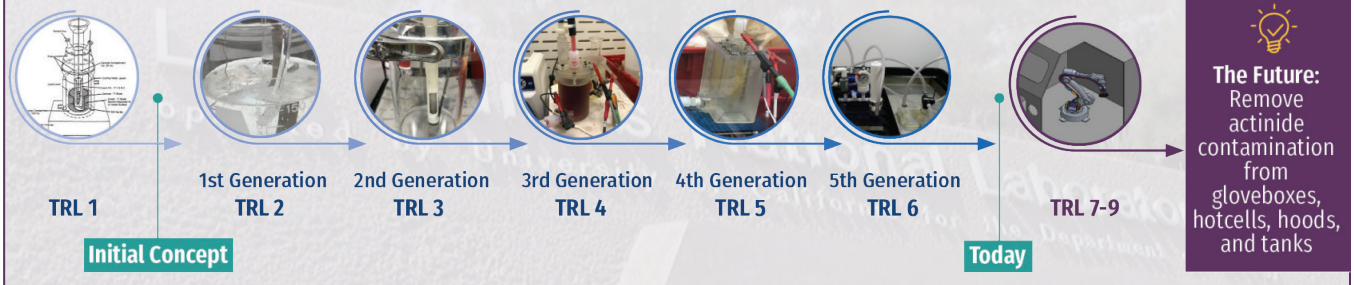
CASE STUDY:

DECONTAMINATION SYSTEM FOR METALS CONTAMINATED WITH ACTINIDE OXIDES

The idea was born in a process developed in the 1970s at Pacific Northwest National Laboratory for batch dissolution of oxides. Scientists knew the process could be adapted for decontamination purposes, but it wasn't until many years later that the required R&D was funded. Los Alamos employee, Ben Karmiol, who leads the effort, started with Mission Foundations Research funds and brought this technology from a concept (TRL 1-2) to a working prototype (TRL 6). Guided by the AIGRB, plans for future development will take the prototype from a manual system to a fully-automated product (TRL 9) that reduces worker dose and product process time, and increases capacity. Actinide oxides are difficult to dissolve, but this system dissolves the oxides in a limited volume, closed-loop process that reduces overall waste and produces lower-level waste while ridding metal surfaces of the contaminated oxides. Reduction in actinide contamination of decommissioned gloveboxes and equipment translates directly to reduced quantities of transuranic (TRU) waste and reduced environmental burden by enabling conversion of waste into a concentrated, insoluble, and stable solid form that will prevent dispersion to the environment.

The process is being developed at Los Alamos specifically for use in decontaminating actinide-contaminated gloveboxes and is further being extended by an LDRD project to the dissolution of refractory actinide oxides traditionally difficult to process. The system is comprised of three main parts: (1) the electrochemical cell (continuously regenerates the cleaning solution); (2) the suction head and delivery system (delivers the cleaning solution to the contaminated metal surface); and (3) separations system (separates cleaning solution from process wastes).

Through the Laboratory's funding of TRL 1-5 via the Glenn T. Seaborg Institute and LDRD, Los Alamos continues to develop the pipeline of innovation required to integrate actinide ST&E and manufacturing.



Technology maturation of the decontamination system's electrochemical cell, where the cleaning solution is regenerated for reuse, has advanced from concept (TRL 1-2) through successful prototype demonstration (TRL 6) and is currently undergoing additional development for the envisioned final product and application addressing real-world challenges.

INTEGRATED INITIATIVE FOR PLUTONIUM AND ACTINIDE MISSIONS

7

LABORATORY AGENDA ITEM 2.6

AN INTEGRATED INITIATIVE FOR PLUTONIUM AND ACTINIDE MISSIONS

The 2020 Laboratory Agenda was published in January 2020 and established strategic objectives in the areas of (1) nuclear security; (2) mission-focused science, technology, and engineering; (3) mission operations; and (4) community relations. The 2020 Laboratory Agenda also identified strategic initiatives in each of the four areas. **Laboratory Agenda Item 2.6** is one of these strategic initiatives and includes the development and implementation of an integrated initiative for plutonium and actinide missions.

As shown in the box to the right, Laboratory Agenda Item 2.6 includes four major bullet points–**Bullets #1 through #4**. Each of these bullets is an integral component in the overall initiative. Each is addressed in its own subsection (*7.1 through 7.4*) and includes:

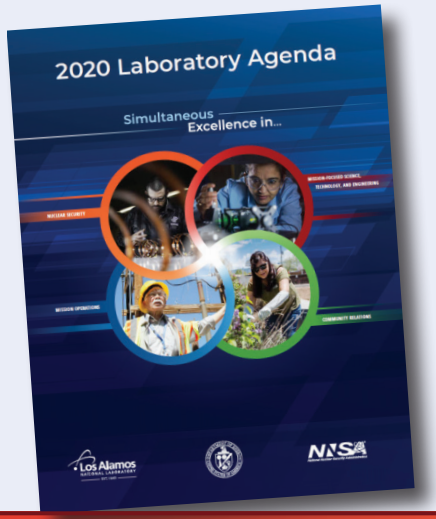
7.1 **Bullet #1** – Internal Strategic Priorities for Actinide Capabilities – presents our time-phased capability needs for this 10-year initiative

7.2 **Bullet #2** – ST&E Roadmap–lies out a broader ST&E Roadmap including key elements for initiative success and again addresses the entire 10-year window for the initiative

7.3 **Bullet #3** – Fiscal Year 2021 Recommended Actions–presents a snapshot of the next year's activities to implement our initiative

7.4 **Bullet #4** – Stewardship Model for Actinide Capabilities– establishes a broader framework of responsibility, interdependencies, and collaboration for future success of the plutonium and actinide missions

Our integrated initiative is a living document that will be updated annually to reflect progress and status of its implementation as well as any changes that come about due to the dynamic nature of our environment or to align with new or changed policy direction.



2020 LOS ALAMOS NATIONAL LABORATORY AGENDA

Item 2.6: Develop and implement an integrated initiative for plutonium and actinide missions

- **Bullet #1** Identify and document **internal strategic priorities for actinide capabilities** (science, engineering, manufacturing) for the near, mid, and long term *(Lead: Stacy McLaughlin)*
- **Bullet #2** Engage stakeholders to draft an **ST&E roadmap** to achieve our strategic goals *(Lead: Franz Freibert)*
- **Bullet #3** Provide **recommendations for FY 2021 actions**, considering management and application of multiple isotopes of Pu; separation/recovery; alloys, materials, and manufacturing; safety, criticality, and security; and linkages with Lab infrastructure planning for radiological and nuclear facilities *(Lead: Stephen Schreiber)*
- **Bullet #4** Work with key stakeholders to develop and implement a **stewardship model for actinide missions**, with an emphasis on the Laboratory's role as the plutonium center of excellence; integrate this model with long-term program priorities in nuclear weapons, in global security, and with DOE *(Lead: Frank Gibbs)*

Frank Gibbs has been assigned overall leadership for Agenda Item 2.6 and has appointed Stephen Schreiber to be the Project Manager for the implementation of the integrated initiative for plutonium and actinide missions. Progress will be internally tracked on a monthly basis as part of the Actinide Operations monthly review meeting and will include separate monthly external oversight. In addition, status will be reported through Frank Gibbs on a quarterly basis to Laboratory leadership. A detailed implementation plan including clear responsibility assignments and the details of the "how" will be developed and executed as an important next step.

7.1 Bullet #1 Internal Strategic Priorities for Actinide Capabilities

In response to **Laboratory Agenda Item 2.6, Bullet #1**, we have identified and documented internal strategic priorities for actinide capabilities in science, engineering, and manufacturing for the near-term (1 year), mid-term (2-3 years), and long-term (4-10 years). These internal strategic priorities are included in **Figure 17** *on the following page*. This figure also identifies the alignment of our strategic priorities for actinide capabilities to our top goals of integrated mission delivery (Goal 1), rapid deployment (Goal 2), assured manufacturing (Goal 3), and next generation workforce (Goal 4).

We have grouped our internal strategic priorities by the categories of science, engineering, and manufacturing and then by the three periods of time specified in the agenda item (near-term, mid-term, and long-term).

In identifying these priorities, we first established the following high level criteria:

1. Overall impact on ability to accomplish the plutonium and actinide missions
2. Capability needed within the 10-year initiative window

Plutonium metal in a glovebox at Los Alamos

2.6 Develop and implement an integrated initiative for plutonium and actinide missions

Bullet #1: Identify and document internal strategic priorities for actinide capabilities (science, engineering, manufacturing) for the near, mid, and long term

Lead: Stacy McLaughlin

"ONE NEVER NOTICES WHAT HAS BEEN DONE; ONE CAN ONLY SEE WHAT REMAINS TO BE DONE."

– Madame Marie Curie

The near-term capability priorities identified herein are carried over into our FY 2021 recommended actions contained in *Section 7.3* in response to **Laboratory Agenda Item 2.6, Bullet #3**.

To achieve our goals and objectives it is imperative that the identified priority capabilities are in place in advance of the mission need. This requires a forward-looking approach to capability development. The identification and documentation of these priority capability needs are important steps toward that end.

Plutonium mission glovebox work

Figure 17
Los Alamos's actinide mission strategic priorities organized by science, engineering, and manufacturing capabilities

SCIENCE CAPABILITIES	ENGINEERING CAPABILITIES	MANUFACTURING CAPABILITIES	KEY PROGRESS TO DATE
NEAR-TERM Strategic Priorities 1. Leverage Seaborg Institute's LDRD Rapid Response call for TRL 1-3 research projects (**Goal 3**) 2. Include mission need in LDRD Mission Foundations Research (TRL 3-5) call (**Goal 2**, **Goal 3**) 3. Invest in workforce development to support and facilitate actinide mission (**Goal 3**) via: • Seaborg postdoctoral fellowships • Summer graduate research assistant (GRA) fellowships • New initiative-focused topic GRA fellowships to address specific needs	**NEAR-TERM Strategic Priorities** 1. Introduce new/modernized equipment capability as captured in the Equipment and Infrastructure List to support manufacturing programs (**Goal 2**) 2. Link Los Alamos development capabilities in radiological facilities (i.e., Sigma, TFF, SM-39) as a test bed for solving challenging manufacturing processes, such as welding, casting, and mold development (**Goal 2**, **Goal 3**) 3. Implement Nuclear Enterprise Science & Technology (NEST) education–for technician pipeline and development (**Goal 4**) 4. Develop technical baseline capture methodology and capability (IT backbone, security, HR, process) for our actinide missions/processes (**Goal 1**)	**NEAR-TERM Strategic Priorities** 1. Implement human resource capability as found in LA-CP-20-20312, Staffing Plan for Plutonium Missions at Los Alamos National Laboratory (**Goal 3**, **Goal 4**) 2. Develop and deploy an agile production management system that will allow for real time production flow and enable electronic product sales (**Goal 2**, **Goal 3**) 3. Implement human resource capability for 24-7 construction and maintenance operations at TA-55 PF-4 (**Goal 1**) 4. Integrate project management, baseline, change control, and business systems, capabilities, and tools to support plutonium and actinide missions (**Goal 1**)	**1. Established real-time capability for measurement (i.e., DYMAC) for NMC&A, Criticality Safety, and Safety Basis–nuclear measurement, modeling, and data analysis capabilities** **2. Successfully completed multiple NET cohorts of technicians trained for glovebox work and fissionable material handling** **3. Enhanced actinides metal separation and purification science (i.e., enhanced precipitation) – Funding as part of Rapid Response call** **4. Established single crystal capability for actinide science** **5. Published Integrated Strategy for Plutonium Missions at Los Alamos National Laboratory (LA-CP-20-20372)**
MID-TERM Strategic Priorities 1. Develop and deploy system/program for closing the prototype and system demonstration (TRL 6-9) gap allowing for cradle-to-grave approach from basic research to product deployment (**Goal 2**) 2. Expand workforce pipeline via Seaborg Institute postdoctoral and GRA fellowships paired between manufacturing and science (**Goal 3**) 3. Enhance actinides metal separation and purification science (i.e., enhanced precipitation) (**Goal 2**)	**MID-TERM Strategic Priorities** 1. Expand NEST capability through university agreement with TAMU investing in current and planned staff through targeted Master's degree programs (**Goal 4**) 2. Expand capability for analogue/surrogate testing utilizing Los Alamos's radiological campus (i.e., Sigma, TFF, SM-39) (**Goal 2**, **Goal 3**) 3. Expand environmental test capabilities for actinide products in support of product certification (**Goal 3**)	**MID-TERM Strategic Priorities** 1. Develop cost model for the preparation of laboratory space for future programs (including PF-4) (**Goal 2**) 2. Deploy wireless solutions in classified manufacturing environments (**Goal 1**, **Goal 3**) 3. Study alternatives for an expanded capability/capacity to store/manage TRU waste (including waste minimization) in the event of WIPP shutdown such that Los Alamos's actinide production missions are not disrupted (**Goal 3**)	
LONG-TERM Strategic Priorities 1. Employ a distributed campus model expanding the current partnerships with universities that make up TAMU, University of California, and other selected universities. Conduct LDRD-funded research at these universities and integrate other funding sources that come to the university (**Goal 1**, **Goal 3**, **Goal 4**) 2. Establish surrogate capabilities at designated universities to support the closure of technology gaps (**Goal 3**, **Goal 4**) 3. Integrate these partnerships into the NEST program so that early career engineers and scientists are working real problems while completing their degree (**Goal 4**)	**LONG-TERM Strategic Priorities** 1. Implement actinide materials processing and testing capability in PF-4 (**Goal 2**, **Goal 3**) 2. Develop partnership with universities for engineering modeling and surrogate validation of manufacturing processes (**Goal 3**, **Goal 4**) 3. Establish modular manufacturing capabilities at universities to include classified manufacturing testing integrated with operations for future deployment at Los Alamos (**Goal 2**, **Goal 3**, **Goal 4**)	**LONG-TERM Strategic Priorities** 1. Establish capability for analogue/surrogate using isotopic purity ^{242}Pu for manufacturing optimization (**Goal 3**) 2. Implement Lean Six Sigma practices to support an optimized flowsheet across product lines and reduce per product footprint allowing for future growth (**Goal 1**) 3. Remove legacy equipment set within PF-4 laboratory spaces providing ready-to-use space for future or expanded missions (**Goal 2**, **Goal 3**)	

Note: Facility recapitalization and infrastructure investments and modernization capabilities are addressed by Agenda Item 3.2. Pit production workforce capabilities are in Agenda Item 1.1.

7.2 Bullet #2 ST&E Roadmap

In response to **Laboratory Agenda Item 2.6, Bullet #2**, we have developed a draft ST&E Roadmap including recommended inputs to the Laboratory Directed Research and Development (LDRD) Strategic Investment Plan (SIP) and recommendations toward the realization of the Plutonium Center of Excellence. The content of this section constitutes the ST&E Roadmap to achieve our strategic goals.

Single crystal of the superconductor plutonium-cobalt-pentagallium

2.6 Develop and implement an integrated initiative for plutonium and actinide missions

Bullet #2 : Engage stakeholders to draft an ST&E roadmap to achieve our strategic goals

Lead: Franz Freibert

"A GOAL WITHOUT A PLAN IS JUST A WISH."

– Antoine de Saint-Exupéry

In considering the path forward to achieve Bullet #2, we will leverage existing Los Alamos strategic documents and strategies toward the accomplishment of our ST&E Roadmap for the plutonium and actinide missions. Importantly, our ST&E Roadmap relies on and leverages the established Los Alamos capability pillar framework. Our team reviewed current published documents and determined that two primary pathways and funding mechanisms would be applied: (1) through the existing program structure, and (2) through the LDRD process and LDRD SIP (issued annually). A key aspect in the success of our integrated initiative will be increasing the visibility and representation of the plutonium and actinide mission needs–and in particular the need for applied science to enable plutonium and actinide missions in Los Alamos laboratory strategies. A desired outcome is to achieve an increased focus within the programs as well as an increased focus and success rate for LDRD-funded projects in support of the plutonium and actinide mission areas. The goal of our draft ST&E Roadmap is to bridge that gap between fundamental science and the needed applied science to support the plutonium and actinide missions in support of manufacturing success.

As such, for the ST&E Roadmap, we are recommending:

1. That the Plutonium Center of Excellence, including Los Alamos's key role as one of two pit manufacturing centers, be appropriately "realized" and formalized. By realizing it, we mean establishing it as a tangible institutional entity with a budget, leadership (i.e., a director), and tangible outcomes including workshops, meetings, and an annual symposium.
2. That we establish a "programmatic" focus area for **Applied Science for Integrated Plutonium and Actinide Mission Delivery** that includes an emphasis on DFM including driving toward "born certified" outcomes for pit manufacturing. This focus area would be integrated as appropriate into existing Los Alamos documents and plans and is designed to help bridge the gap and strengthen integration between early TRL and MRL. Using the SIP document framework structure as our starting point, we have crafted draft text summarizing this potential new focus area for pursuit (See *Page 36*). This recommendation does not include any change to existing pillars, but only integration with existing pillars by the recommended addition of a new focus area.
3. That the plutonium and actinide core team work with leadership for the Weapons Systems capability pillar to integrate the programmatic focus area described in item 2 above into a new focus area within the Weapons Systems capability pillar beginning with the FY 2022 or FY 2023 LDRD SIP. We will work collaboratively to develop an emphasis within the Weapons Systems capability pillar on applied science in support of plutonium and actinide missions, including science that enables DFM success and supports realization of Los Alamos as the Plutonium Center of Excellence. Importantly, and in keeping with the spirit of the integrated initiative for plutonium and actinide missions, this new focus area would involve integration among multiple pillars.

These Los Alamos capability pillars predominantly include Weapons Systems, Science of Signatures, Materials for the Future, and Complex Natural and Engineered Systems.

4. That through more active participation and collaboration by weapons and actinide operations leadership in the LDRD process, we increase the focus of research calls and project funding in the area of Applied Science for Integrated Plutonium and Actinide Mission Delivery to bridge the gap from TRL 1-3 to TRL 6-9.
5. That Laboratory strategy documents be updated as appropriate in conjunction with annual/routine periodic updates to include an emphasis on the Plutonium Center of Excellence, including Los Alamos's preeminent roles as the design authority for pits, the leader in plutonium research and development, and its continuing leadership in pit manufacturing.
6. That the list of strategic priorities for actinide capabilities developed in response to **Laboratory Agenda Item 2.6**, **Bullet #1** (as well as our applicable FY 2021 recommended actions in response to **Laboratory Agenda Item 2.6**, **Bullet #3**) be integrated elements of our ST&E Roadmap. It is our intent that the content of both *Sections 7.1 and 7.3* be a part of our overall ST&E Roadmap.
7. That a key part of our ST&E Roadmap will include the closer integration of TRL and MRL to support realization of DFM objectives and rapid deployment, including shifting certification methodology from processed-based certification to product-based certification in order to achieve "born certified" pit manufacturing.

As the lead for Agenda Item 2.6, Frank Gibbs will closely track progress and status through routine monthly progress meetings and official quarterly reviews, and will lead annual updates to our integrated initiative.

ST&E Roadmap Stakeholders

- Field Office Manager, NNSA-LA
- Deputy Administrator for Defense Programs, DOE-NNSA Headquarters (through NNSA-LA)
- ALD, Weapons Production
- ALD, Global Security
- ALD, Weapons Engineering
- ALD, Weapons Physics
- ALD, Physical Sciences
- ALD, Chemical, Earth, and Life Sciences
- Division Leader, Materials Science & Technology
- Division Leader, Chemistry
- Senior Director, Partnerships and Pipeline
- Division Leader, Sigma
- Chair, Triad Board ST&E Committee
- Principal Associate Director, Weapons and Complex Integration, Lawrence Livermore National Laboratory
- Director, Nuclear Deterrence; ALD and Chief Engineer for Nuclear Weapons, Sandia National Laboratories
- ALD, Nuclear Science and Technology, Idaho National Laboratory
- Deputy for Science and Technology, Oak Ridge National Laboratory
- ALD, National Security, Savannah River National Laboratory
- Laboratory Director, Stanford Linear Accelerator Center
- Director, Savannah River Site Pit Production Mission
- Director, Seaborg Institute-Los Alamos
- Director, Seaborg Institute-LLNL
- Director, Seaborg Institute-INL
- Director, Seaborg Institute-LBNL
- Associate Vice President, University of California National Laboratories
- Vice Chancellor of Engineering and National Laboratories, Texas A&M University (TAMU)

Stakeholder Engagement in ST&E Roadmap

We have defined our list of stakeholders for the ST&E Roadmap (see highlight box), developed an engagement plan, and conducted initial outreach and engagement. Following our submittal of this document in October 2020, and incorporation of Laboratory leadership feedback, we will conduct additional stakeholder engagement activities as outlined in our engagement plan. Under our engagement plan, we will:

- Send identified stakeholders an introductory email asking for their support/participation in a remote engagement activity
- Send draft ST&E Roadmap concepts to identified stakeholders for review with a feedback questionnaire
- Internally socialize draft ST&E Roadmap with Los Alamos leadership and stakeholders
- Receive and compile written feedback, including feedback from Laboratory leadership
- Hold initial engagement discussion workshops–one for ST&E Roadmap and one for Stewardship Model
- Incorporate inputs received from stakeholder engagement into the FY 2022 annual update to the initiative

It is our goal to complete our engagement activities by the end of December 2020. The finalized ST&E Roadmap and programmatic focus area will be provided as appropriate for incorporation into the next updates of relevant Los Alamos strategies and plans including the FY 2023 LDRD SIP.

7.2.1 Addressing Our Actinide Mission Challenges

This roadmap will establish the path to achieve our strategic goals and serve in developing a long-term Stewardship Model for actinide missions. A key element of the ST&E Roadmap and for a credible Stewardship Model (addressed in **Laboratory Agenda Item 2.6, Bullet #4**) is solidifying Los Alamos's role as the Plutonium Center of Excellence. The ST&E Roadmap necessary to meet the applied science and production technology need is broad and requires a mission-driven applied science and technology focus. To integrate with long-term program priorities in nuclear deterrence, and global and energy security, our top four goals as previously presented in *Section 2* have guided the ST&E Roadmap and Stewardship Model development. These include integrated mission delivery, rapid deployment, assured manufacturing, and next generation workforce.

In addition to realizing the Plutonium Center of Excellence, our ST&E Roadmap includes instituting a Subject Matter Expert-guided strategic investment methodology to include:

- Programmatic investment in ST&E that enables plutonium and actinide mission delivery with an emphasis on DFM, rapid deployment, and assured manufacturing to close the gap in both TRL and MRL
- LDRD MFR and Direct Strategic Investment to address rapid technology deployment and close the technology maturation gap
- Director's Initiative Rapid Response call, Seaborg Institute GRA and Postdoctoral Fellows programs, and strategic university partnerships and collaborations
- Strategic Investment to address the science-technology transfer gap
- Establishment of a DFM methodology (including a drive toward "born certified" for pit manufacturing) as an end state of applied science, production technology development, and maturation effort, ensuring a rapid deployment pathway and enabling assured manufacturing goals

As we move toward implementation of our ST&E Roadmap, we will:

- Engage internal and external stakeholders in development of our implementable plan
- Expand engagement of university partners to ensure research efforts
- Conduct applied science and integrated delivery to close gap from foundational to applied science to achieve technology maturation and enable rapid deployment
- Ensure that rapid deployment is enabled through DFM

Strategic investment plays an essential role in furthering the 2020 Los Alamos Agenda Item 2.6 and includes:

- Supporting high-risk, high-reward applied science and research to address grand challenges and our plutonium and actinide mission programmatic focus area
- Providing short-term seed funds for postdoctoral fellows, early career scientists, and engineers to initiate research aimed at providing the capabilities and technical underpinnings for multi-year technology development projects
- Fostering sustained excellence and enhanced internal and external visibility in relevant applied science as measured by invited talks, technical reports, peer-reviewed publications, and postdoctoral researchers, early career scientists, and engineers developing research proposals and projects
- Establishing an intellectual community to facilitate the nucleation of novel ideas to solve timely and important relevant actinide mission scientific and technological problems and initiate rapid deployment of those solutions
- Leveraging investment through LDRD as well as garner and implement strategic programmatic investment

10-Year End State

Figure 18 *on the following page* illustrates our desired progress to achieve our 10-year End State under our ST&E Roadmap for Applied Science for Integrated Plutonium and Actinide Mission Delivery.

Infrastructure – Infrastructure modernization and increased capacity are a key enabler to plutonium and actinide mission success as described in *Section 6.10.* Establishment of the Plutonium Production Science Facility (PF-4) and the Radiological Campus (TA-35, -48, -53), are needed to deliver assured manufacturing and rapid deployment goals and provide long-term sustainability for plutonium and actinide missions.

Figure 18

ST&E Roadmap 10-year vision – closing the gap

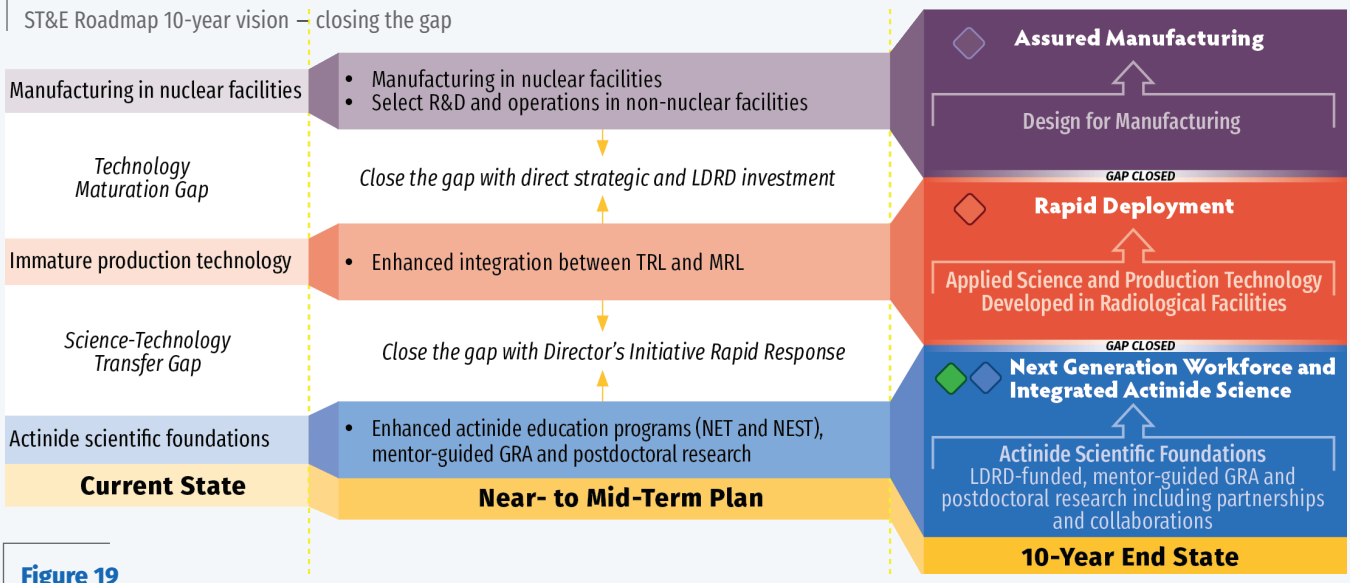
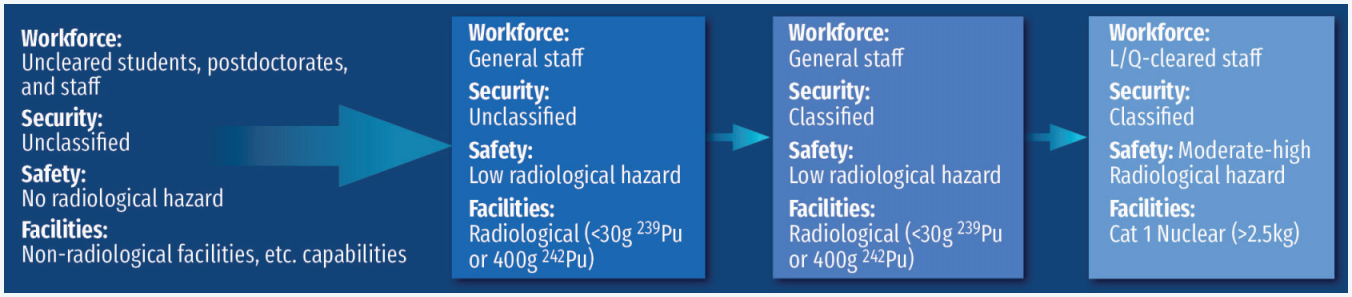


Figure 19

Increasing workforce requirements – unclassified non-radiological to classified nuclear facility



Workforce Pipeline – The plutonium and actinide workforce at Los Alamos will need to increase by ~1,400 between now and 2025. Developing our next generation workforce is a key enabler of plutonium and actinide mission success as described in *Section 6.9*. **Figure 19** *above* illustrates the increasing complexity in the level of workforce requirements from uncleared non-nuclear at the left through cleared workforce for classified work in nuclear facilities at the right. A large part of this will be our partnerships with universities and institutes to attract the GRAs and postdoctoral fellows to support growing ST&E needs. Where feasible, we will maximize the utilization of university-based personnel and facilities to (1) perform supporting unclassified research and development, and (2) establish the main source of the personnel pipeline.

Plutonium CENTER OF EXCELLENCE for RESEARCH AND DEVELOPMENT

Plutonium Center of Excellence – To fulfill our obligations as a Center of Excellence, Los Alamos shoulders an immense responsibility to steward and understand plutonium in all its applications. We have an obligation to lead plutonium science, engineering, and technology development and manufacturing across a broad range of plutonium-centric programs and to continue to lead pit manufacturing efforts. Increasing and expanding our understanding of the first-principles behavior of plutonium requires a diverse and deep set of scientific skills, along with unique facilities, complex experimental tools, and the world's most powerful computational capabilities.

A key desired outcome is to establish a realized Plutonium Center of Excellence to address integrated mission delivery in a safe, compliant, and securely designed environment to achieve rapid deployment in support of plutonium and actinide mission priorities.

The realization of this vision will ensure the Laboratory's important stewardship role. Our realized Plutonium Center of Excellence will include a named director with liaisons from our Associate Laboratory Directorates and will become host to workshops, town halls, and an annual symposium. This realized vision turns the Plutonium Center of Excellence from an honorary designation into something tangible that is recognizable as a national asset with an organization dedicated to nucleating mission critical innovation and fostering technological growth.

Because plutonium is among the most complex of all elements, exhibiting a most remarkable and puzzling set of engineering properties, it requires the best talent that our laboratories and U.S. universities have to offer. Our mission now is to re-qualify old pits and/or to re-manufacture them. Both routes offer significant technological challenges. Re-qualification requires that we understand how plutonium ages to determine how quickly the key properties of plutonium change and the effect of such changes on performance. Re-manufacturing is challenging because it will now be performed by a reconstituted workforce, with different processes and in different facilities without being able to physically test the final weapons. So, to certify the weapons in the stockpile today and in the future by extending the lifetimes of pits or re-manufacturing them, we must understand plutonium better. We have to rely on the collective history of plutonium science generated over 75 years and develop new experiments and new models to help guide the judgment of the designers and engineers. We must continue to expand our fundamental scientific understanding of plutonium—one that can be more readily preserved and taught to future generations.

7.2.2 Establishment of a New Focus Area for Plutonium and Actinide Missions

We propose to add a new programmatic focus area titled Applied Science for Integrated Plutonium and Actinide Mission Delivery. This focus area will be a programmatic focus area for research and development activities in support of the plutonium and actinide missions. To the extent achievable, we will also work collaboratively with the Weapons Systems pillar leadership and the LDRD Strategy Team to have this focus area added to the LDRD SIP beginning in FY 2023. It is not our intent in anyway to change the current pillars but only to add a new focus area or integrate elements of the focus area into existing ones if adding a new focus area to the SIP is not attainable.

The intent of this new focus area is to help drive funding of Laboratory research for calls that support delivery of the plutonium and actinide missions through applied science. The FY 2021 LDRD SIP featured five Focus Areas—Information Science and Technology, Materials for the Future, Science for Signatures, Nuclear and Particle Futures, and Complex Natural and Engineered Systems. We recommend opening a dialogue to add a focus area under the new Weapons Systems capability pillar to specifically target ST&E that optimizes the delivery of the plutonium and actinide missions through applied science. The focus area will include an emphasis on rapid deployment and design for manufacturing processes to enable mission success for current and future plutonium and actinide missions. This new applied science focus area will leverage knowledge gained through fundamental science to solve manufacturing challenges and optimize productivity. It will emphasize DFM to ensure that Los Alamos retains its excellence in plutonium and actinide missions.

Establishing this new focus area (and potentially adding it to the SIP) is consistent with the Administration's R&D budget priorities including American Security/Advanced Military Capabilities, Industries of the Future/ Advanced Manufacturing, American Energy and Environmental Leadership, and American Space Exploration and Commercialization. In addition, it aligns with NNSA's LDRD strategic objective to "enhance the laboratories' ability to address current and future DOE/NNSA missions" in part through addressing the challenge of providing "an agile, flexible, and effective nuclear deterrent" as stated in the 2019 Strategic Framework NNSA Laboratory and Site-Directed Research and Development (July 1, 2019). Research and development activities under this focus area will either be funded through carving out additional programmatic investment or through the existing LDRD mechanism. Utilizing the existing LDRD SIP is preferable so as not to distract from or diminish the Laboratory's well-established LDRD mission.

Figure 20 *on the following page* includes draft language for the recommended new focus area. The framework for this language is based on the current structure for focus areas within the FY 2021 LRDR SIP. Initially, this will serve as a programmatic focus area but the desire is to work with Weapons Systems pillar leadership and in collaboration with other capability pillars to have it added as a formal focus area for future SIPs.

Figure 20 Suggested draft language for new focus area

Establishment of a New Focus Area

The following draft text is intended for use to establish a new focus area either programmatically or within the existing LDRD SIP structure. The format and wording was created to align with (mirror) the current LDRD SIP document structure for its focus areas.

Focus Area: Applied Science for Integrated Plutonium and Actinide Mission Delivery

Leads: Frank Gibbs and Franz Freibert

New Start Goals: 2-4 new starts per year

Description: Los Alamos is faced with many future challenges with respect to our mission to manufacture plutonium pits to achieve 30 ppy by 2026 in support of the U.S. weapons program. In addition, Los Alamos will be expected to reliably produce the next generation of weapons components as the United States endeavors to optimize its future nuclear weapons capabilities. At the same time, NASA relies on Los Alamos to ensure its need for heat sources for space exploration is provided at a rate necessary to meet NASA's mission timelines and needs. To meet the manufacturing and production deliverables for NNSA and NNSA's end-user partners (DoD, NASA, SC, DHS, NE, and the oil and gas industry), Los Alamos must not only provide the fundamental materials science to support innovation and next generation discovery, but the Laboratory must provide applied science for the next generation solutions in integrated plutonium and actinide mission delivery. This effort requires a paradigm shift to pursue in parallel the ever-important fundamental science while simultaneously investing in applied science. Applied science will help us optimize our delivery so that we can achieve assured manufacturing that is repeatable, reliable, and meets delivery schedules and product quality requirements–over and over again. Applied science will also enable us to achieve a more rapid deployment of design changes or new weapons designs so that we can go from concept to deployment in years rather than decades.

A key aspect of rapid deployment is DFM. We need to go from DFM being a phrase that gets a mention now and again, to a way of life, so that we begin with the end in mind. This will allow us to ultimately innovate and design weapons components, heat sources, or other plutonium and actinide products in a way that makes them more simple to manufacture; more easily repeatable; safer to build and store; easier to transport, assemble, and disassemble; and, importantly, easier to certify (under a "born certified" approach).

This new area of focus is centered on the science, technology, and engineering that ***DELIVER*** the plutonium and actinide missions across all eight of our mission priority areas, resulting in manufacturing success.

Scope

Applied science for integrated plutonium and actinide mission delivery focuses on plutonium and actinide materials, science, and R&D applicable to the manufacturing of the products produced at Los Alamos as part of our plutonium and actinide missions. This includes pits, heat sources/RTGs, future weapons components, plutonium oxide, americium oxide, and recovered/recycled uranium oxide and/or metal.

This focus area supports applications that are aligned with the Los Alamos mission areas of energy security, nuclear deterrence, and nonproliferation, as well as space exploration. Under the plutonium and actinide mission, energy security includes providing americium for well logging sources in support of oil and gas exploration and heat sources to power space exploration; nuclear deterrence and nonproliferation includes plutonium pit and RTG manufacturing, weapons disassembly, and recovered/recycled uranium. This focus area will foster:

- Applied science in support of pit manufacturing
- Applied science in support of heat sources and RTG manufacturing
- Applied science in support of nonproliferation efforts, including disassembly, recovery, and recycling
- Applied science in support of oil and gas industry americium sources
- Applications in reliability science and design for manufacturing

Priorities

This focus area will support our top plutonium and actinide mission priorities including:

- Produce plutonium pits for the nuclear weapons stockpile
- Produce RTGs for the nuclear weapons stockpile and ^{238}Pu heat sources for use by NASA in space exploration
- Evaluate pits returned from the nuclear weapons stockpile to support annual stockpile assessments and to inform future pit designs
- Produce plutonium components for assembly into devices used in subcritical experiments
- Perform fundamental science on the material properties and aging of plutonium
- Process plutonium into forms suitable for disposition to support nonproliferation goals
- Recover americium for the DOE-SC
- Conduct uranium operations in support of weapons and nuclear energy programs

Mission Drivers

- Nuclear Posture Review 2018
- National Security Strategy of the United States, December 2017
- Administration's FY 2021 Research and Development Priorities
- Los Alamos National Laboratory Integrated Strategy for Plutonium Missions at Los Alamos National Laboratory, June 2020–Official Use Only
- NNSA's FY 2020 Stockpile Stewardship and Management Plan
- Los Alamos Materials for the Future Strategic Plan
- White House Space Policy Directive 1 (SPD-1), December 2017

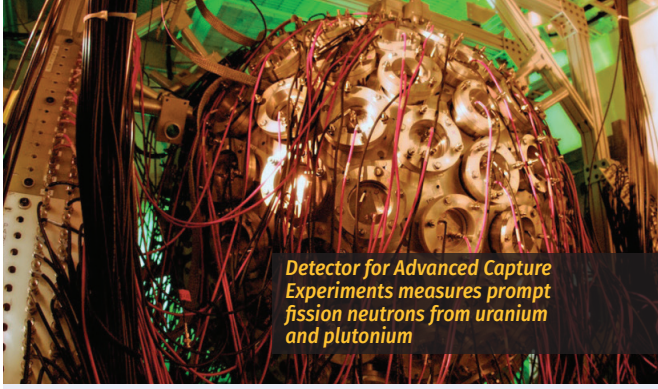
7.3 Bullet #3 Fiscal Year 2021 Recommended Actions

In response to **Laboratory Agenda Item 2.6, Bullet #3**, we have developed a list of recommended actions for FY 2021. Our FY 2021 recommended actions take into consideration the management and application of multiple isotopes of plutonium; separation and recovery; alloys, materials, and manufacturing; safety, criticality, and security; and linkages with Laboratory infrastructure planning for radiological and nuclear facilities.

Our recommended actions are grouped in accordance with our plutonium and actinide mission top level goals and objectives as described in *Section 2* and listed in **Figure 3**. The recommended actions are also aligned to our near-term strategic priorities for actinide capabilities in science, engineering, and manufacturing as described in *Section 7.1* and listed in **Figure 17**. **Figure 21** *below* shows the alignment of our near-term strategic priorities with our FY 2021 recommended actions. **Figure 22** *on the following page* lists our 32 FY 2021 recommended actions aligned to our goals and objectives.

For FY 2021, we will focus on executing the identified and prioritized near-term (within 1 year) strategic priorities for actinide capabilities as well as completing actions that contribute toward accomplishing our key objectives and ultimately our goals.

These recommended actions will become a key element of our implementation plan, which will be developed under next steps as described in *Section 8* and managed by Stephen Schreiber, our project manager for implementation. Through our implementation plan, each action will be assigned to a responsible manager who will be accountable for completion of the action in the specified time frame.



Detector for Advanced Capture Experiments measures prompt fission neutrons from uranium and plutonium

2.6 Develop and implement an integrated initiative for plutonium and actinide missions

Bullet #3 : Provide recommendations for FY 2021 actions, considering management and application of multiple isotopes of Pu; separation/recovery; alloys, materials, and manufacturing; safety, criticality, and security; and linkages with Lab infrastructure planning for radiological and nuclear facilities

Lead: Stephen Schreiber

"AN IDEA NOT COUPLED WITH ACTION WILL NEVER GET ANY BIGGER THAN THE BRAIN CELL IT OCCUPIED."

– Arnold H. Glasow

Figure 21

Near-term strategic priorities aligned to FY 2021 recommended actions

Science Capability	FY 2021 RECOMMENDED ACTION
Strategic Priority #1	Action #3
Strategic Priority #2	Action #6
Strategic Priority #3	Action #26

Engineering Capability	FY 2021 RECOMMENDED ACTION
Strategic Priority #1	Action #17
Strategic Priority #2	Action #11
Strategic Priority #3	Action #29
Strategic Priority #4	Action #23

Manufacturing Capability	FY 2021 RECOMMENDED ACTION
Strategic Priority #1	Action #27
Strategic Priority #2	Action #21
Strategic Priority #3	Action #28
Strategic Priority #4	Action #22

GOAL #1: INTEGRATED MISSION DELIVERY

OPTIMIZE INTEGRATION OF MANUFACTURING, ST&E, AND MISSION OPERATIONS TO DELIVER NEXT GENERATION SOLUTIONS FOR PLUTONIUM AND ACTINIDE MISSIONS

Objective 1A:

Leverage existing Laboratory Directed Research and Development (LDRD) strategy team and new Director's Initiative annual rapid response funding to maximize actinide operations science Rapid Response by FY 2023.

Action 1: Work with 3.1 Laboratory Agenda team to establish a senior leadership position and/or direct report organization tasked with the integration of ST&E, Mission Operations, and the Weapons Mission, including integration of plutonium and actinide missions. This new organization would drive horizontal integration across our vertical chain of command.

Action 2: Establish Actinide Operations and Pit Program membership and representation for the LDRD Strategy Team to increase Weapons Production/ Actinide Operations participation. Achieve and sustain continuous participation beginning Q1 FY 2021.

Action 3: Work with the Seaborg Institute to award FY 2021/FY 2022 Rapid Response projects in enhanced actinides metal separation and purification science to advance capabilities needed to enable Laboratory mission agility and scientific advancement by Q3 FY 2021.

Action 4: Demonstrate meaningful progress on 2020 projects under the Director's Initiative 2020 LDRD Rapid Response new start projects during FY 2021.

Objective 1B:

Update, maintain, and implement the ST&E Roadmap, with a focus on Rapid Response/science support for actinide missions annually beginning in FY 2020 through FY 2030 and beyond.

Action 5: Engage key stakeholders and conduct FY 2021 Annual Update of ST&E Roadmap by Q4 FY 2021.

Objective 1C:

Bridge the gap from LDRD to implementation. Establish and implement a new Program Technology-Based Development Initiative (direct programmatic, agreed upon contribution to a program) to fund mission delivery-focused actinide science by Q4 FY 2022.

Action 6: Ensure inclusion of actinide mission needs in LDRD Mission Foundations Research call for FY 2021 and FY 2022.

Action 7: Establish an Actinide Integrated Governance and Review Board in FY 2021 through the ALDWP-AO-Technical Applications Office, to bridge technologies from development in LDRD to implementation through shared programmatic return on investment.

Action 8: Engage key stakeholders and develop drafts of actinide mission-focused Program Development Initiatives by end of Q3 FY 2021.

GOAL #2 RAPID DEPLOYMENT

ACHIEVE WEAPON CONCEPT TO DELIVERY IN YEARS VERSUS DECADES

Objective 2A:

Fully implement Design for Manufacturing (DFM) by FY 2025 and create first DFM WR-capable pit by FY 2026. (Ties to Laboratory Agenda Item 1.1)

Action 9: Incorporate DFM implementation into existing integrated program baseline by Q2 FY 2021.

Objective 2B:

Fully implement a framework for rapid implementation of Nuclear Security Enterprise Product Realization Process and Defense Programs Business Practices System (DPBPS) process by FY 2023.

Action 10: Working with internal stakeholders, develop rapid DPBPS framework by Q4 FY 2021.

Objective 2C:

Leverage use of lower hazard category (radiological) facilities with reduced regulatory burden and greater agility for small-scale science by end of FY 2022.

Action 11: Link Los Alamos's capabilities in radiological facilities [i.e., Sigma Complex SM-66 at TA-3, Target Fabrication Facility (TFF) at TA50, Shops SM-39 at TA-3, Radiological Facility at TA-48, etc.] as test beds for solving challenging manufacturing processes such as welding, casting, and mold development.

Action 12: Create a first draft of an updated Radiological Campus Strategy and implementation plan for small scale science by Q1 FY 2021, conduct engagement of facility owners/stakeholders in Q2-Q3 FY 2021, and finalize it in Q4 FY 2021.

GOAL #3 ASSURED MANUFACTURING

ACHIEVE PREDICTABLE AND REPEATABLE DELIVERY THROUGH FOCUSED, STANDARDIZED, AND ENABLING OPERATIONAL EXCELLENCE

Objective 3A:

Establish formal integrated mechanisms to enable assured manufacturing between now and FY 2022. (Ties to Laboratory Agenda Items 3.2 and 3.3)

Action 13: Implement our Actinide Integrated Governance and Review Board to tie SMPs to make integrated mission-focused decisions and address critical issues related to NMC&A, nuclear safety, criticality safety, and classification enhancements. Develop the Charter and Board makeup by Q1 FY 2021 and fully implement it by Q4 FY 2021.

Action 14: Develop needs forecast for support functions (to be updated quarterly) to inform support organizations of needs and requirements 2-5 years out by Q4 FY 2021.

Action 15: Establish "Fix It Now" Team with working level operations, criticality, nuclear safety, radiological safety, waste, etc. to rapidly address and resolve emerging time-sensitive issues in the field to support sustained manufacturing by Q3 FY 2021.

Action 16: Develop real-time capability for measurement (i.e., DYMAC) for NMC&A, Criticality Safety, and Safety Basis with nuclear measurement, modeling, and data analysis capabilities by Q4 FY 2021.

Action 17: Establish new/modernized equipment capability as captured in the Equipment and Infrastructure List to support manufacturing programs by Q4 FY 2021.

Objective 3B:

Create a broad-based employee and organizational performance incentive structure tied to science and manufacturing mission success for implementation in FY 2023. (Ties to Laboratory Agenda Items 3.1, 3.2, and 3.5)

Action 18: Develop a draft of revised employee performance incentive/merit structure by Q4 FY 2021 for execution during the FY 2022 cycle.

Objective 3C:

Drive creation of a standardized and consistent higher bounding safety basis–DSA–within actinide science and manufacturing facilities by Q4 FY 2024. (Ties to Laboratory Agenda Item 3.3)

Action 19: Conduct a pilot project to implement an integrated and standardized higher bounding safety basis/DSA for waste facilities by Q4 FY 2021.

Objective 3D:

Establish and maintain modernized reliable infrastructure capabilities (facilities, equipment, technology) for predictable program delivery and operational excellence by Q4 FY 2026.

Action 20: Develop an infrastructure capabilities requirements matrix for actinide missions by Q2 FY 2021.

Action 21: Develop and deploy an agile production management system that will allow for real time production flow and enable electronic product sales building upon the pilot work on heat source production and extending into the Plutonium Sustainment program by 4Q FY 2021.

Action 22: Develop integrated project management, baseline, change control, and business systems, capabilities, and tools to support plutonium and actinide missions by Q4 FY 2021.

Action 23: Establish a technical baseline capture methodology and capability (IT backbone, security, human resource, process) for the actinide missions/ processes by Q4 FY 2021. **(Ties to Laboratory Agenda Item 3.2)**

GOAL #4 NEXT GENERATION WORKFORCE

GROW OUR NEXT GENERATION WORKFORCE WITH A FOCUS ON ACTINIDE COMPETENCY

Objective 4A:

Integrate with Mission Operations to develop and/or hire ~1,400 plutonium and actinide competent workers between now and FY 2025. (Ties to Laboratory Agenda Items 1.1, 3.5, and 4.2)

Action 24: Develop an integrated baseline that ensures inclusion of resource needs to level of detail necessary for workforce competency and capability planning by Q3 FY 2021.

Action 25: Establish New Employee Training (NET) success with multiple cohorts of technicians trained for glovebox work and fissionable material handling by Q2 FY 2021.

Action 26: Make investment in pipeline development to support and facilitate Los Alamos actinide missions via:

- Seaborg postdoctoral fellowships
- Summer GRA fellowships
- New initiative-focused topic GRA fellowships to address specific needs

Action 27: Implement human resource capability as found in LA-CP-20-20312, Staffing Plan for Plutonium Missions at Los Alamos National Laboratory.

Action 28: Implement human resource capability for 2nd shift construction and maintenance operations at TA-55 PF-4.

Objective 4B:

Integrate with Mission Operations to develop recruitment, retention, education, and training initiatives for next generation workforce by Q4 FY 2022. (Ties to Laboratory Agenda Item 1.1 and 3.5)

Action 29: Initiate Nuclear Enterprise Science & Technology (NEST) program - for technician education and worker qualification in Q1 FY 2021.

Action 30: Produce first NEST certificate and NET graduates under an integrated NEST Program 4Q FY 2021.

Action 31: Develop a formal time-phased five-year recruitment plan to support plutonium and actinide missions by Q2 FY 2021.

Action 32: Complete the Continuing Training Compliance Project by Q4 FY 2022.

Figure 22
FY 2021 recommended actions aligned to goals and objectives

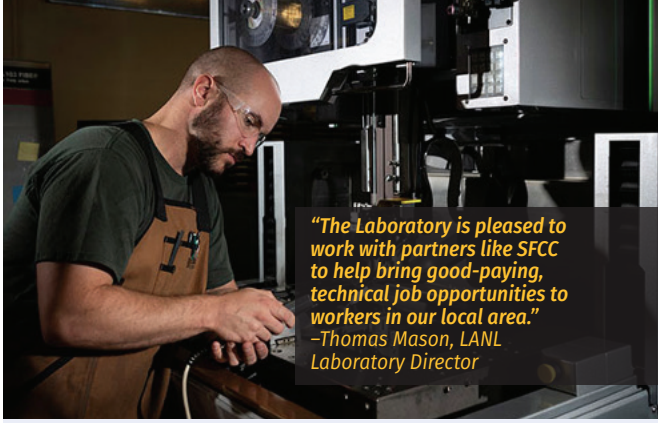
7.4 Bullet #4 Stewardship Model for Actinide Missions

In response to **Los Alamos Laboratory Agenda Item 2.6, Bullet #4**, we have developed a draft Stewardship Model for actinide missions and prepared a draft responsibility assignment matrix (RAM). Our draft model includes an emphasis on the Laboratory's role as the Plutonium Center for Excellence. Our draft model and RAM are integrated with long-term program priorities in nuclear weapons and global security, as well as the priorities of DOE and NNSA. We have developed a stakeholder engagement plan taking into account the impacts of COVID-19 and have initiated stakeholder engagement on both the Stewardship Model and the RAM.

For the purpose of responding to Agenda Item 2.6, stewardship is defined as the management or care of resources and capabilities in the service of others and through the office, duties, and obligations of a steward. In our case, we have identified Robert Webster as the steward for the actinide missions at Los Alamos. Our draft Stewardship Model provided as **Figure 23** *on Page 41* includes all major entities with a role in ensuring successful delivery of plutonium and actinide missions at Los Alamos. The model created consists of an organogram that corresponds with our Stewardship Model RAM (as shown on **Figure 24** *on Pages 42-44*) and addresses the office and proposed duties and obligations of each entity.

Stewardship theory was introduced by Donaldson and Davis in 1989 as an alternative to the agency theory. Under agency theory, the agent's role is to represent the principals' (stakeholders') best interest from a business/opportunistic perspective. On the other hand, under the Stewardship Model, the agent (steward) acts out of social responsibility in a caretaker capacity to altruistically serve the principals (stakeholders) and protect their collective and mutual best interests. The steward, rather than being opportunistic, is driven to do a good job, to be a good steward of the plutonium and actinide mission. Stewardship theory argues that the alignment between agents (stewards) and principals (stakeholders) is reflective of a psychological contract and based on a mutually beneficial relationship with the steward behaving in a community-focused manner, directing trustworthy moral behavior toward the Laboratory's actinide missions and its stakeholders. A Stewardship Model encourages a collaborative environment based on shared principles and pride in performance, and is focused on mutual success.

A Stewardship Model at its core has three predominant aspects–leadership, stewardship, and governance. Simplistically, the model includes stewards and stakeholders, but for the Los Alamos actinide missions, we have further identified proposed roles and responsibilities for a range of stewards and stakeholders, including governance, as shown on **Figure 24**.



2.6 Develop and implement an integrated initiative for plutonium and actinide missions

Bullet #4 : Work with key stakeholders to develop and implement a stewardship model for actinide missions, with an emphasis on the Laboratory's role as the plutonium center of excellence; integrate this model with long-term program priorities in nuclear weapons, in global security, and with DOE

Lead: Frank Gibbs

"BY MAINTAINING LOS ALAMOS AS THE NATION'S PLUTONIUM CENTER OF EXCELLENCE FOR RESEARCH AND DEVELOPMENT, THE RECOMMENDED ALTERNATIVE IMPROVES THE RESILIENCY, FLEXIBILITY, AND REDUNDANCY OF OUR NUCLEAR SECURITY ENTERPRISE BY NOT RELYING ON A SINGLE PRODUCTION SITE."

– Lisa Gordon-Hagerty, Under Secretary for Nuclear Security and NNSA Administrator

Our Stewardship Model enables those stewards managing the plutonium and actinide operations to assume both responsibility and accountability to work internally with Mission Operations and with external regulators to ensure an appropriate balance is achieved to safely execute national missions within established time frames and budgets. Likewise, the model helps to define how the steward(s) work with collaborators, customers, sender and receiver sites, and through NNSA (our end-user partners) in alignment to deliver the plutonium and actinide mission.

Plutonium Center of Excellence

The background and our roadmap and vision for the Los Alamos Plutonium Center of Excellence was previously provided in *Section 7.2.1*. The Center of Excellence is an important element of our Stewardship Model serving in a stewardship role across the nation for plutonium excellence in pit manufacturing and ST&E, and as the design authority for pits.

To fulfill our obligations as the Plutonium Center of Excellence, Los Alamos shoulders an immense responsibility to steward and understand plutonium in all its applications and to deliver excellence in pit manufacturing. We have an obligation to lead plutonium science, engineering, and technology development across a broad range of plutonium-centric programs. Understanding the first-principles behavior of plutonium requires a diverse and deep set of scientific skills, along with unique facilities, complex experimental tools, and the most powerful computers in the world.

Stakeholder Engagement in Stewardship Model

We have defined our list of stakeholders (see left column of **Figure 23**), developed an engagement plan, and conducted initial outreach and engagement. Following our submittal of this document in October 2020, and incorporation of Laboratory leadership feedback, we will conduct additional stakeholder engagement activities as outlined in our engagement plan, which follows the same process as our engagement for the ST&E Roadmap as presented in *Section 7.2*.

It is our goal to complete our engagement activities by the end of December 2020. Then the finalized Stewardship Model and RAM will be provided to Los Alamos Laboratory Leadership and it will continue to evolve based on annual updates and future engagement.

This document will be updated annually to reflect progress and any changes in priorities, new directives, or the strategic environment. During even years, a more thorough revision will be conducted. In addition, progress will be reviewed and reported on a quarterly basis.

Figure 23

ACTINIDE MISSIONS STEWARDSHIP MODEL

STAKEHOLDER: "ONE WHO IS INVOLVED IN OR AFFECTED BY A COURSE OF ACTION"
–Merriam-Webster

STEWARDSHIP MODEL STAKEHOLDERS

- Field Office Manager, NNSA-Los Alamos
- Deputy Administrator for Defense Programs, DOE-NNSA Headquarters (through NNSA-LA)
- Deputy Director, Weapons
- Deputy Director, ST&E
- Deputy Director, Operations
- ALD, Weapons Production
- ALD, Weapons Engineering
- ALD, Weapons Physics
- ALD, Global Security
- ALD, Physical Sciences
- ALD, Chemical, Earth, and Life Sciences
- ALD, Simulation and Computation
- ALD, Business Management
- ALD, ESHQSS
- ALD, Facilities and Operations
- ALD, Capital Projects
- Director, Actinide Operations
- Division Leader, Materials Science & Technology
- Division Leader, Chemistry
- Senior Director, Partnerships and Pipeline
- Division Leader, Sigma
- Senior Director, Weapons Production Environment & Waste Programs
- Director, Human Resources
- Chair, Triad Board ST&E Committee
- Principal Associate Director, Weapons and Complex Integration, LLNL
- Director, Nuclear Deterrence; ALD and Chief Engineer, Nuclear Weapons, SNL
- ALD, Nuclear Science and Technology, INL
- Deputy for Science and Technology, ORNL
- ALD, National Security, SRNL
- Laboratory Director, Stanford Linear Accelerator Center
- Director, Plutonium Processing Facilities Missions, SRS
- Senior Manager, Nevada National Security Site (NNSS)
- President, Kansas City National Security Campus (KCNSC)
- Site Manager and Senior Director, Pantex Plant (Pantex)
- Senior Vice President and Uranium Processing Facility Director, Y-12 National Security Complex (Y-12)
- Director, Seaborg Institute-Los Alamos
- Director, Seaborg Institute-LLNL
- Director, Seaborg Institute-INL
- Director, Seaborg Institute-LBNL
- Associate Vice President, University of California National Laboratories
- Vice Chancellor of Engineering and National Laboratories, Texas A&M University
- Chancellor, University of New Mexico (ABQ and LA)
- President, Santa Fe Community College
- President, Northern New Mexico College
- Chair, Los Alamos County Council
- Pueblo Governor/Chairman, Northern New Mexico Pueblos
- Mayor, City of Santa Fe
- Chair, Northern New Mexico Citizens Advisory Board

2.6 Develop and implement an integrated initiative for plutonium and actinide missions

Bullet #4 : Work with key stakeholders to develop and implement a stewardship model for actinide missions, with an emphasis on the Laboratory's role as the plutonium center of excellence; integrate this model with long-term program priorities in nuclear weapons, in global security, and with DOE

Lead: Frank Gibbs

GOVERNANCE

- **Federal:** NNSA Federal Oversight, NNSA Governance Steering Committee, NNSA-Los Alamos Oversight
- **Triad Board of Directors**
- **Triad Board Committees:** Finance, Audit and Ethics; Human Resources and Compensation; Mission; Operations; and Science, Technology, and Engineering
- **Actinide Integrated Governance and Review Board** *NEW*

STEWARDSHIP: "THE CAREFUL AND RESPONSIBLE MANAGEMENT OF SOMETHING ENTRUSTED TO ONE'S CARE"
–Merriam-Webster

♦ Collaborative Problem-Solving ♦ Accountable Stewardship ♦ Commitment ♦ Shared Outcomes

INTERNAL COLLABORATORS
John Sarrao, Deputy Director, ST&E
ST&E ALDs

INTERNAL ENABLERS
Kelly Beierschmitt, Deputy Director, Operations
Operations ALDs

EXTERNAL COLLABORATORS
Seaborg Institutes: Los Alamos, LLNL, INL, LBNL
University of California System
Texas A&M University
Santa Fe Community College
Northern New Mexico College

STEWARD FOR ACTINIDE MISSIONS -
responsible for ensuring Actinide Mission success

ROBERT WEBSTER, DEPUTY DIRECTOR, WEAPONS
Weapons Mission ALDs
Director, Actinide Operations
Actinide Strategy Executive Body: David Clark, Franz Freibert, Frank Gibbs, Stacy McLaughlin, Stephen Schreiber *NEW*

PLUTONIUM CENTER OF EXCELLENCE FOR RESEARCH AND DEVELOPMENT
Director: *NEW*
Liaisons: ST&E, LDRD, Weapons, Operations

EXTERNAL REGULATORS
Defense Nuclear Facilities Safety Board
New Mexico Environment Department
U.S. Environmental Protection Agency
U.S. Department of Transportation

DOE SUPPLIER SITES
Y-12 (sends enriched ^{238}Pu, iridium hardware, and heat source subcomponents to Los Alamos)
KCNSC (sends WR hardware, tooling, testers, process materials, RTGs to Los Alamos)
SNL Design Agency (provides component specifications, drawings to Los Alamos)
LLNL Design Agency (provides component specifications, drawings to Los Alamos)
Pantex (sends pits, RTGs, and Pu metal to Los Alamos)
NNSS (sends Pu metal to Los Alamos)

SHARED OUTCOMES
✓ Greater nuclear security
✓ World peace
✓ Scientific advancement
✓ Exploration and innovation
✓ Nonproliferation

OUR CUSTOMER
NNSA National Nuclear Security Administration
DOE-NNSA Headquarters
NNSA-Los Alamos
From NNSA Mission:
"to protect the American people by maintaining a safe, secure, and effective nuclear weapons stockpile and by reducing global nuclear threats"

EXTERNAL STAKEHOLDERS
Los Alamos County
Northern New Mexico Pueblos
City of Santa Fe
Northern New Mexico Citizens Advisory Board

DOE RECEIVER SITES
LLNL (receives Pu samples from Los Alamos)
NNSS (receives pits and Pu components for testing from Los Alamos)
Y-12 (receives excess/recycled/depleted uranium from Los Alamos)
SRS (receives Pu oxide from Los Alamos)
Pantex (receives war reserve pits and RTGs from Los Alamos)
INL (receives flight-quality heat sources from Los Alamos)
SNL (stockpile data from RTG destructive testing from Los Alamos)
DOE Office of Science (receives Americum oxide from Los Alamos)
WIPP (receives TRU waste from Los Alamos)

END-USER PARTNERS
- U.S. Department of Defense
- National Aeronautics and Space Administration
- U.S. Department of Homeland Security
- DOE Office of Science
- DOE Office of Nuclear Energy
- Oil and gas industry

BENEFICIARIES
- American people
- Larger international community
- Select NATO forces
- Larger International Community (including UK Atomic Weapons Establishment)

NNSA NUCLEAR SECURITY ENTERPRISE = National Laboratories: SNL, LLNL, Los Alamos **Manufacturing:** KCNSC, Pantex, Y-12, SRS, Los Alamos **Test Site:** NNSS

Figure 24

Actinide missions draft stewardship responsibility assignment matrix

Name and/or Organization	Draft/Recommended Stewardship Role	Draft/Recommended Key Stewardship Responsibilities
NNSA Headquarters	**Governance:** National Federal Governance and Oversight **Our Customer:** Primary Customer and Funding Agency	• Provide Federal oversight • Set long-term NSE mission strategy and priorities • Foster integration across the U.S. Nuclear Security Enterprise • Collaborate with End-User Partners to ensure mission alignment • Provide programmatic direction for nuclear weapons/actinide programs • Provide funding and priorities for weapons programs and supporting actinide missions
NNSA-Los Alamos	**Governance:** Site Level Federal Governance and Oversight **Our Customer:** Primary Customer and Contract Administrator	• Provide local Federal oversight • Set Los Alamos mission strategy and priorities • Collaborate with End-User Partners on details of mission and product needs • Foster integration with sender, receiver sites • Provides contract implementation for weapons programs and actinide mission areas • Provides direct operational oversight for Los Alamos/Triad
Triad Board of Directors, Board of Observers	**Governance:** Corporate and Academic Parent Governance and Oversight	• Provide corporate and academic oversight to Triad • Provide avenues for reachback support from corporate parents and academic systems • Set expectations and review performance (safety, financial, performance)
Triad Board Committees	**Governance:** Corporate and Academic Parent Governance and Oversight	• Provide committee level guidance and direction • Review performance for area of committee expertise • Provide lessons learned from other endeavors
Actinide Integrated Governance and Review Board *NEW*	**Governance:** Laboratory Level Integrated Governance – Cross-Directorate	• Serves as vehicle for integrated prioritization and decision making • Arbitrates competing needs among directorates for greater good of overall actinide mission • Reviews issues and matters of key concern to ensure timely resolutions
Robert Webster, Deputy Director Weapons	**Steward:** Primary Steward for Actinide Missions	• Accountable to the Laboratory Director for Actinide Mission success • Recommends candidates for Director and Liaisons to the Board of Directors for appointment to lead the Plutonium Center of Excellence • Collaborates and integrates across Actinide Missions Stewardship Model • Assigns Weapons ALDs stewardship actions
Weapons Mission ALDs	**Steward:** Supporting Stewards for Actinide Missions	• Accountable to the Laboratory Director for successful performance of their directorate • Ensures that the actions of their respective directorate support achievement of overall plutonium and actinide mission goals • Appoints delegate(s) to the Actinide Integrated Governance and Review Board
Frank Gibbs, Director, Actinide Operations	**Steward:** Deputy Steward for Actinide Missions	• Serves as Robert Webster's lead resource in ensuring actinide mission success • Lead for implementing Agenda Item 2.6; chairs quarterly progress reviews • Oversees and appoints Chair of the Actinide Strategy Executive Body
Actinide Strategy Executive Body	**Steward:** Strategic Steward for Actinide Missions	• Recommends science/research calls and awards under the Director's Initiative • Responsible for development and implementation of actions associated with the Laboratory Agenda Item 2.6 • Integrates with members of other Directorates to ensure delivery success • Maintains and updates plutonium and actinide strategic initiative and ST&E Roadmap
Director, Plutonium Center of Excellence *NEW*	**Steward:** National Center of Excellence	• Provides leadership in innovation in plutonium pit manufacturing, R&D, and design • Fosters a community of plutonium manufacturing, R&D, and design • Inspires and supports development of next generation plutonium leaders, scientists, and engineers • Develops annual symposium workshop for plutonium manufacturing, science, R&D, and design
John Sarrao, Deputy Director, ST&E	**Internal Collaborator:** ST&E Leadership	• Fosters an environment of integration and collaboration in support of the plutonium and actinide missions • Provides leadership for fundamental and applied science to enable the success of plutonium and actinide missions • Directs LDRD in areas that support rapid deployment, DFM, and applied needs of the plutonium and actinide missions • Ensures annual LDRD SIP includes a focus on applied science in support of plutonium and actinide missions
ST&E ALDs	**Internal Collaborator:** ST&E Leadership	• Collaborates on a day-to-day basis with plutonium and actinide mission stewards to ensure plutonium and actinide mission success • Identifies ST&E opportunities for applied science that supports delivery of the plutonium and actinide missions • Leads, manages, and implements applied science that supports plutonium and actinide mission delivery

Name and/or Organization	Draft/Recommended Stewardship Role	Draft/Recommended Key Stewardship Responsibilities
Kelly Beierschmitt, Deputy Director, Operations	**Internal Enabler:** Mission Operations Leadership	• Provides leadership to Mission Operations that includes enabling plutonium and actinide mission success as a key organizational objective • Fosters an environment that enables and not restricts the operational envelop for plutonium and actinide missions • Ensures the people, infrastructure, and business structure are in place to support actinide mission delivery–including the actinide next generation workforce
Operations ALDs	**Internal Enabler:** Mission Operations Leadership	• Collaborates on a day-to-day basis with plutonium and actinide mission stewards to ensure plutonium and actinide mission success • Identifies Mission Operations opportunities to streamline processes, solve challenges, and enable success • Leads, manages, and implements Mission Operations functions under their area that enable actinide mission delivery
Seaborg Institutes: Los Alamos, LLNL, INL, LBNL	**External Collaborator:** ST&E Collaborator and Peer Review	• Collaborates on research for design, operations, and manufacturing • Serves in peer review role in design and research • Collaborates on the development of engineers, scientists, and operations personnel
University of California System	**External Collaborator:** University System Partner	• Develops fundamental curricula for actinide science disciplines • Delivers academic curricula for the development of scientists and engineers to support actinide science • Provides supporting research facilities and faculty to support the development of actinide science
Texas A&M University	**External Collaborator:** University System Partner	• Develops fundamental curricula for actinide science disciplines • Delivers academic curricula for the development of scientists and engineers to support actinide science • Provides supporting research facilities and faculty to support the development of actinide science
Santa Fe Community College (SFCC)	**External Collaborator:** Local College	• Develops curricula for actinide related operations disciplines • Delivers curricula for the development of multiple operations disciplines including research technicians, radiological control technicians, and maintenance craft to support actinide science • Provides relevant offerings such as machinist training
Northern New Mexico College	**External Collaborator:** Local College	• Develops curricula for actinide related operations disciplines • Delivers curricula for the development of multiple operations disciplines including research technicians, radiological control technicians, and maintenance craft to support actinide science • Provides relevant offerings
Defense Nuclear Facilities Safety Board	**External Regulator:** Congressional Oversight of NNSA	• Provides nuclear operations oversight of NNSA • Provides independent reporting to U.S. Congress
New Mexico Environment Department	**External Regulator:** Environmental Regulator	• Provides oversight to cleanup activities including cleanup criteria • Provides regulatory oversight and approval for discharge permits • Provides regulatory oversight of waste operations
U.S. Environmental Protection Agency (EPA)	**External Regulator:** Environmental Regulator	• Provides oversight and enforces permit compliance • Provides regulatory oversight and approval for discharge permits • Provides regulatory oversight for EPA-regulated aspects of waste, including asbestos
US Department of Transportation (DOT)	**External Regulator:** Regulator for Shipment of Nuclear Material and Waste	• Regulatory oversight for nuclear material transportation including compliance with DOT regulations • Regulatory oversight for transport of nuclear waste including LLW, LLMW, and TRU waste • Links DOT regulations with DOE regulations for transport containers
Y-12	**DOE Supplier Site:** NNSA Production agency **DOE Receiver Site:** Recipient of excess/ recycled/depleted uranium	• Supplier of nuclear components supporting the NNSA mission • Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges
KCNSC	**DOE Supplier Site:** NNSA Production site	• Supplier of non-nuclear components supporting NNSA missions • Collaborator in application of production technologies
SNL	**DOE Supplier Site:** NNSA Design Agency **DOE Receiver Site:** Recipient of data from destructive testing	• Serves as design agency for NNSA nuclear weapons components • Serves as design agency for NNSA for RTG components including certification requirements • Serves in design agency RTG surveillance role • Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges

Name and/or Organization	Draft/Recommended Stewardship Role	Draft/Recommended Key Stewardship Responsibilities
LLNL Design Agency	**DOE Supplier Site:** NNSA Design Agency **DOE Receiver Site:** Recipient of Los Alamos samples	• Serves as design agency for NNSA nuclear weapons components • Serves in pit surveillance design agency role • Provides requirements for certification of nuclear weapons components • Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges
Pantex	**DOE Supplier Site:** NNSA Assembly facility **DOE Receiver Site:** Recipient of pits and RTGs	• Provides facilities, people, and processes for assembly of nuclear weapons • Maintains nuclear stockpile for NNSA • Provides capabilities for implementation of weapon LEPs • Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges
NNSS	**DOE Supplier Site:** NNSA Test Site **DOE Receiver Site:** Recipient of test components	• Provides nuclear testing for weapons certification • Provides LLW and LLMW disposal sites • Provides experimental test facilities for experimental science activities supporting actinide research • Communicates with Los Alamos and coordinates timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges
SRS	**DOE Receiver Site:** Recipient of plutonium oxides and Los Alamos Design Authority information	• Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges • Interfaces with Los Alamos regarding Design Authority aspects
INL	**DOE Receiver Site:** Recipient of heat sources	• Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges
DOE Office of Science	**DOE Receiver Site:** Recipient of americium oxide	• Communicates with Los Alamos and coordinates receipts, timing, and logistics • Provides feedback and works with Los Alamos to optimize interfaces • Communicates needs, supports timely resolution of any challenges
WIPP	**DOE Receiver Site:** Recipient of TRU waste from Los Alamos	• Provides TRU waste repository • Provides certification capability for TRU waste • Regulatory oversight of TRU waste producing sites
US Department of Defense	**End-User Partner:** Sets Final Product Requirements	• Establishes military characteristics for weapons components and systems • Sets production demands for nuclear weapons/components (quantities and timing)
National Aeronautics and Space Administration	**End-User Partner:** Sets Final Product Requirements	• Funding Agency (through NNSA) for heat source products • Design agency for heat source products for NASA missions • Sets production demands for heat sources (quantities and timing) corresponding to exploratory mission needs
US Department of Homeland Security	**End-User Partner:** Sets Final Product Requirements	• Funding Agency (through NNSA) for DHS Applications • Design agency for DHS applications • Establishes timing and needs for support from Los Alamos
DOE Office of Science	**End-User Partner:** Sets Research Program Objectives for Actinide Science	• Funding Agency for Office of Science Research Programs • Sets requirements for Office of Science research programs including production of americium
DOE Office of Nuclear Energy	**End-User Partner:** Sets Requirements for Nuclear Energy Research	• Funding agency for nuclear energy research for commercial applications, such as nuclear fuel and reactor designs • Sets requirements for nuclear energy research and development programs
Oil and gas industry	**End-User Partner:** User of well logging sources for oil and gas exploration	• End-user of well logging sources for oil and gas exploration • Provides feedback on needs and timing of needs as well as potential optimizations
American people	**Beneficiary:** Protected through NNSA missions of global security, deterrence, and nonproliferation	• Provide feedback on policies through U.S. democratic process • Indirectly provides funding through taxation
Larger international community (including UK Atomic Weapons Establishment)	**Beneficiary:** Research Collaborator	• Collaborates in the research, development, and manufacture of nuclear weapons • Collaborates in operation and maintenance of nuclear infrastructure • Provides peer review for research and development activities
Los Alamos County, Northern New Mexico Pueblos, City of Santa Fe, Northern New Mexico Citizens Advisory Board	**External Stakeholder:** Community stakeholders	• Participates in Los Alamos community education and engagement activities • Supports Los Alamos efforts to develop local workforce in support of plutonium and actinide missions

CONCLUSION AND ROADMAP

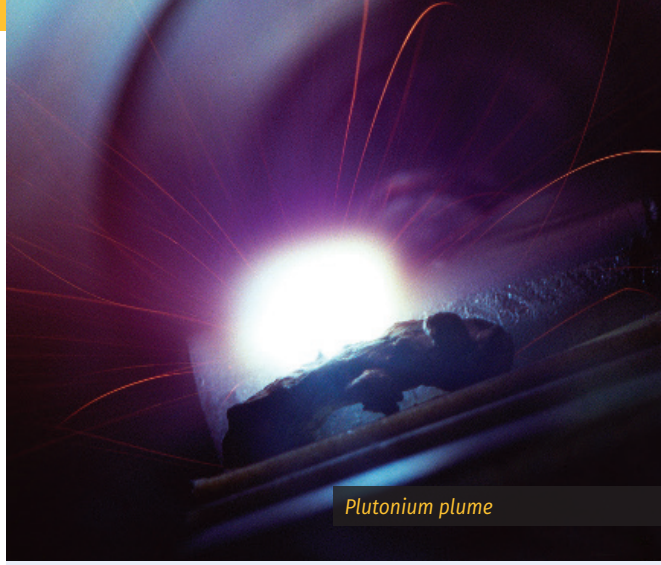
8

CONCLUSION AND ROADMAP TO THE FUTURE

In assessing the Los Alamos plutonium and actinide mission priorities, we have been entrusted with diverse challenges and great responsibility by the NNSA, the Administration, the American people, and our Allies around the world. Our mission areas provide components, products, or processing capability to multiple end-users in support of our nation's nuclear stockpile and nuclear deterrence, nonproliferation, foundational science, space exploration, and oil and gas energy exploration. This document constitutes the first issuance of our integrated initiative for plutonium and actinide missions in response to **Laboratory Agenda Item 2.6**.

This is a first and important step toward achieving our mission goals of integrated mission delivery, rapid deployment, assured manufacturing, and next generation workforce. Our next steps include engagement and feedback from Laboratory leadership, further engagement of key stakeholders regarding our draft ST&E Roadmap and draft Stewardship Model, implementation of our recommended FY 2021 actions, and development of implementation plans in support of achievement of our goals, objectives, and capability priorities as defined herein. The integration of the plutonium and actinide missions is of key importance to the success of the overall Los Alamos and NNSA missions.

This initiative will be implemented over the next decade to enable current and future plutonium and actinide mission success. **Figure 25** *on the following page* provides our plutonium and actinide missions roadmap to the future.



Plutonium plume

The key elements of our integrated initiative include the following:

- Plutonium and actinide mission strategic goals and objectives and recommended FY 2021 actions toward achieving those objectives
- Plutonium and actinide mission area and enabler descriptions
- Identification and engagement of plutonium and actinide mission key stakeholders
- Identification and documentation of internal strategic priorities for actinide capabilities in the near-, mid-, and long-term
- A draft ST&E Roadmap tied to achievement of our strategic goals and objectives
- A Stewardship Model for actinide missions that includes an emphasis on the Plutonium Center of Excellence

In summary our next steps include:

1) Conducting ongoing stakeholder engagement, including with Laboratory leadership
2) Developing a detailed implementation plan importantly including clear responsibility assignments and details on the "how." This implementation plan will be executed under the direction of our designated Project Manager for implementation Stephen Schreiber.
3) Conducting internal monthly progress meetings and formal quarterly status reviews led by Frank Gibbs
4) Updating this document anually, including a comprehensive review and update every other year beginning in FY 2022

Figure 25

PLUTONIUM AND ACTINIDE MISSIONS ROADMAP TO THE FUTURE

PLUTONIUM AND ACTINIDE MISSION VISION:
To achieve integrated mission delivery, rapid deployment, and assured manufacturing through the world class capabilities of our next generation workforce.

MISSION:
To solve plutonium and actinide mission challenges through our integrated initiative and simultaneous excellence.

PLUTONIUM AND ACTINIDE GOALS

GOAL #1: INTEGRATED MISSION DELIVERY
Optimize integration of manufacturing, ST&E, and mission operations to deliver next generation solutions for plutonium and actinide missions.

GOAL #2: RAPID DEPLOYMENT
Achieve weapon concept to delivery in years versus decades.

GOAL #3: ASSURED MANUFACTURING
Achieve predictable and repeatable delivery through focused, standardized, and enabling operational excellence.

GOAL #4: NEXT GENERATION WORKFORCE
Grow our next generation workforce with a focus on actinide competency.

"BY MAINTAINING LOS ALAMOS AS THE NATION'S PLUTONIUM CENTER OF EXCELLENCE FOR RESEARCH AND DEVELOPMENT, THE RECOMMENDED ALTERNATIVE IMPROVES THE RESILIENCY, FLEXIBILITY, AND REDUNDANCY OF OUR NUCLEAR SECURITY ENTERPRISE BY NOT RELYING ON A SINGLE PRODUCTION SITE."
– Lisa Gordon-Hagerty, Under Secretary for Nuclear Security and NNSA Administrator, May 10, 2018

ENABLERS

- Workforce
- Operational Excellence
- Infrastructure
- Integration

MISSION PRIORITY AREAS

1. Produce Plutonium Pits
2. Produce ^{238}Pu Heat Sources and RTGs
3. Evaluate Pits Returned from the Stockpile
4. Process Plutonium for Nonproliferation
5. Produce Plutonium Components for Subcritical Experiments
6. Conduct Science on Material Properties and Aging of Plutonium
7. Recover Americium
8. Conduct Uranium Operations

10-YEAR TIMELINE

1st pit production unit FY 2023

Sustained production of 30 pits per year

Equipment and infrastructure to support pit ramp up

Achieve sustained rate of 500 kgs of plutonium oxide per year beginning in FY 2025

Complete FY 2021 Recommended Actions per Section 7.3

Objective 1B: Update, maintain, and implement the ST&E Roadmap, with a focus on Rapid Response/science support for actinide missions annually beginning in **FY 2020** through **FY 2030** and beyond.

Objective 1A: Leverage existing Laboratory Directed Research and Development (LDRD) strategy team and new Director's Initiative annual Rapid Response funding to maximize actinide operations science Rapid Response by **FY 2023**.

Objective 2B: Fully implement a framework for rapid implementation of Nuclear Security Enterprise Product Realization Process and Defense Programs Business Practices System (DPBPS) process by **FY 2023**.

Objective 3B: Create a broad-based employee and organizational performance incentive structure tied to science and manufacturing mission success for implementation in **FY 2023**.

Objective 4A: Integrate with Mission Operations to develop and/or hire ~1,400 plutonium and actinide competent workers between now and **FY 2025**.

Achieve 20 pits per year FY 2025

Achieve peak staffing of 3,563

NEAR-TERM — **MID-TERM** — **LONG-TERM**

FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 | FY 2026 | FY 2027 | FY 2028 | FY 2029 | FY 2030

Objective 1C: Bridge the gap from LDRD to implementation. Establish and implement a new Program Technology-Based Development Initiative (direct programmatic, agreed upon contribution to a program) to fund mission delivery-focused actinide science by **Q4 FY 2022**.

Objective 2C: Leverage use of lower hazard category (radiological) facilities with reduced regulatory burden and greater agility for small-scale science by end of **FY 2022**.

Objective 3A: Establish formal integrated mechanisms to enable assured manufacturing between now and **FY 2022**.

Objective 4B: Integrate with Mission Operations to develop recruitment, retention, education, and training initiatives for next generation workforce by **Q4 FY 2022**.

Objective 3C: Drive creation of a standardized and consistent higher bounding safety basis–Documented Safety Analysis (DSA)–within actinide science and manufacturing facilities by **Q4 FY 2024**.

Achieve 10 pits per year FY 2024

New TRU Liquid Waste Facility

Objective 2A: Fully implement Design for Manufacturing (DFM) by FY 2025 and create first DFM WR-capable pit by **FY 2026**.

Objective 3D: Establish and maintain modernized reliable infrastructure capabilities (facilities, equipment, technology) for predictable program delivery and operational excellence by **Q4 FY 2026**.

TA-55 fire system upgrades

Fabricate RTGs at an annual production rate provided by NNSA

Infrastructure and modernizations

Maintain heat source production for NASA to steady rate of 15 per year